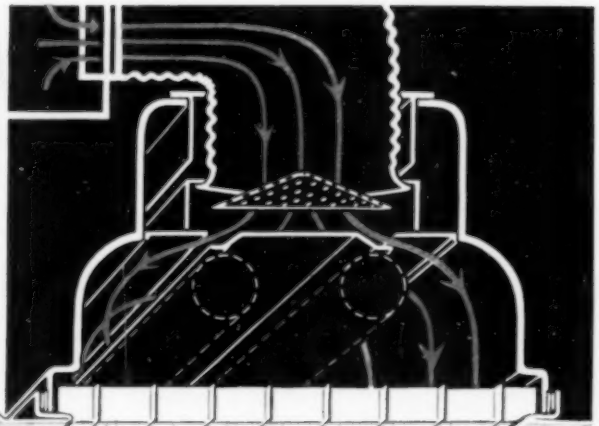
NOVEMBER 1956

ie

ILLUMINATING ENGINEERING

Journal of the
ILLUMINATING ENGINEERING SOCIETY

2 in 1



A great improvement in Air Conditioning is born INSIDE a lighting unit! Cold air is efficiently diffused along the entire length of the fixture through the unique Multi-Vent Diffuser Plate. A multitude of vents disperses air along the contour of the reflector, resulting in a gentle downward diffusion of the air for truly draft-free air conditioning.

both LIGHT and AIR from the SAME fixture!

Here is a lighting unit that does something about room temperatures, too! The new 2-in-1 Benjamin Multi-Vent Trofferlite delivers both the most modern illumination and improved air diffusion from the same fixture at a decided cost saving. It brings you well-diffused, adequately-shielded Benjamin-engineered light conditioning, in combination with a new advance in gently-diffused, draft-free air conditioning. Ceilings take on a modern, uncluttered look because air diffusers are concealed inside the clean-lined troffer lighting units. Installation costs dip way down, as the 2-in-1 feature reduces the number and variety of fixtures required. Wherever light and air conditioning are needed, specify Benjamin Multi-Vent Trofferlites to make the job simpler, the design more beautiful, the air conditioning more successful and the cost much lower! Send for FREE illustrated 8-page Data Brochure. Write Benjamin Electric Mfg. Co., Dept. I, Des Plaines, Illinois.

B-1472

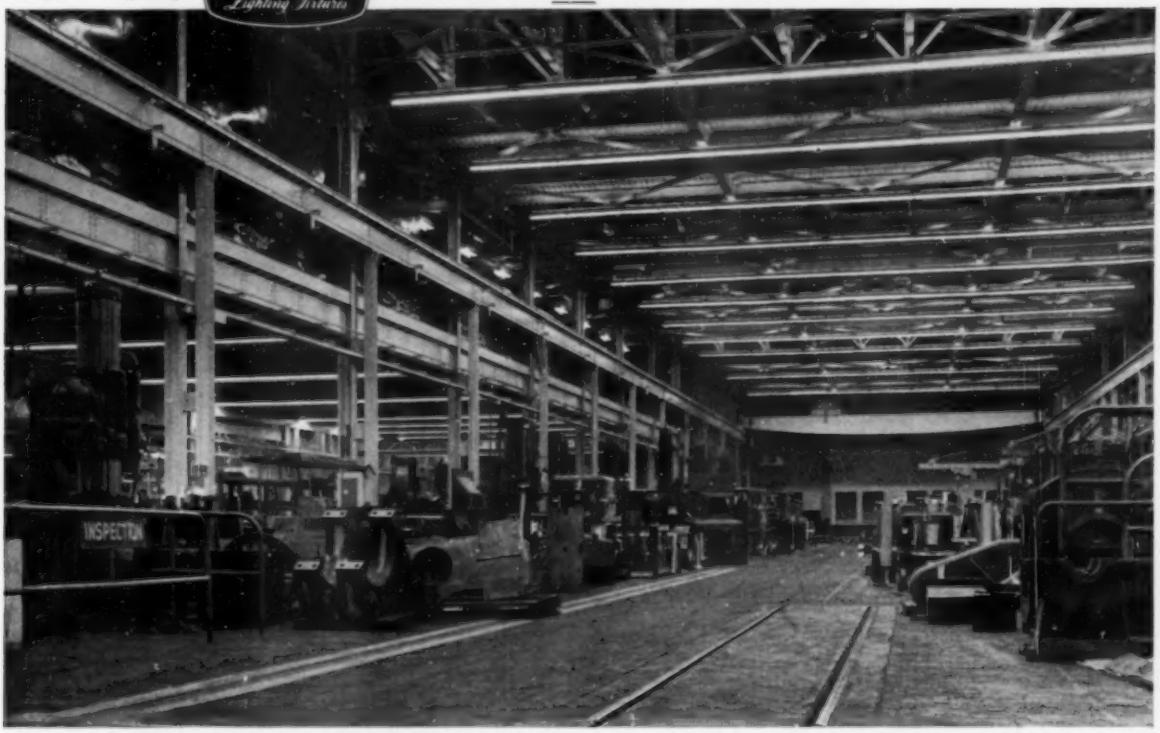
Now — Advanced Benjamin Light Conditioning
PLUS Greatly Improved Air Conditioning from one unit!

No double installation problems!
Improved draft-free air conditioning!
Benjamin-engineered illumination!
No discord of fixtures!

BENJAMIN
MULTI-VENT TROFFERLITE
2-IN-1 LIGHT AND AIR DIFFUSION SYSTEM

Trofferlite by Benjamin Electric Mfg. Co. • Multi-Vent® Air Diffuser by Pyle National Co.

Lighting by DAY-BRITE Lighting Fixtures makes the big difference...

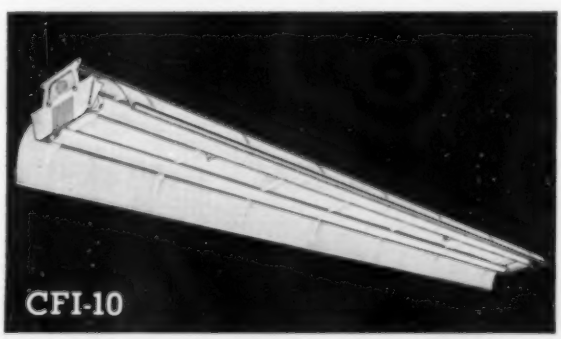


Versatility of New Day-Brite CFI Fixtures is illustrated in this recent high-bay installation for Beloit Iron Works, Beloit, Wisc. Mounted 29 ft. above the floor, Day-Brite's CFI-10 Industrial Fixtures with High-output Rapid-start lamps furnish an average of 40 ft.-candles.

High-bay — high-output
New Day-Brite **CFI** Industrial Fixtures

In this significant installation, both quality and quantity of light achieved with Day-Brite CFI (*Comfort For Industry*) fixtures are readily apparent. In addition, and of particular value in a high-bay installation, maintenance is greatly simplified. New High-output Rapid-start lamps with slotted openings in reflector tops permit natural updraft ventilation. This keeps reflectors cleaner longer—means extra light at no extra cost.

Before you decide on plant or office lighting, consult your Day-Brite representative. He's listed in your phone directory. Or, send for CFI literature.



Reduce eye fatigue—by directing a portion of the light *upwards*, harsh ceiling contrasts are washed out—eye fatigue and discomfort are greatly reduced—greater accuracy and improved production result.

51178

DAY-BRITE LIGHTING, INC.
5432 Bulwer Ave., St. Louis 7, Mo.

Nation's largest manufacturer of commercial and industrial lighting equipment

DAY-BRITE Lighting Fixtures

THREE-YEAR GUARANTY

Starring & Company agree to correct, by replacement or repair at its option and conditioned upon return to our factory for inspection, such Starring Ballasts as may fail in service within a period of three years from date of shipment, provided that conditions of operation have been normal at all times and that the Ballasts have not been subjected to abnormal stresses from such causes as incorrect primary voltages or frequency, or improper ventilation. This Guaranty is limited to replacement or repair of defective parts, free of charge.

STARRING & COMPANY, INC.

1600 Seaview Avenue Bridgeport 8, Connecticut EDison 4-0108

ie

ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

November 1956

Vol. LI, No. 11

1956-1957 Officers

President
M. N. Waterman

Vice-President
Kirk M. Reid

Vice-President
George J. Taylor

General Secretary
R. G. Slauer

Treasurer
J. B. Browder

•

Editor
Ruby Redford

•

Advertising Manager
Clayton E. Ellis

•

Assistants
Barbara Lamson, Editorial
Adelaide Philiba, Advertising

•

Publications Committee
J. S. Schuchert, Chairman
Brooks Chassaing
H. F. Davidson
R. W. Morris
R. M. Zabel

•

Executive Secretary
A. D. Hinckley

Technical Director
C. L. Crouch

Contents

713 Goddard Trophy Established for "My Most Interesting Lighting Job"

714 Luminaire Design — for Large-Area, Low-Ceiling Drafting Room, First Prize MMILJ, B. F. Jones

717 House with a View Toward Living, Second Prize MMILJ, Dorothy McGregor

720 The Light Is Right at Mutual, Third Prize MMILJ, E. H. Schaefer

722 The Evaluation of Discomfort Glare — Glenn A. Fry

729 I.E.S. Lighting Data Sheet — Series XXI
Lighting for a Modeling Platform (12-99)

731 Plastics in Lighting — W. E. Brown, P. C. Woodland, R. J. Lee

743 Measuring Electrical Output of Rapid Start Ballasts by a Light Output Method — R. D. Bradley and M. M. Buzan

745 New Developments in Short Arc Lamps — Theodore C. Retzer and George W. Gerung

753 I.E.S. Lighting Data Sheet — Series XXI
Lighting a Shoe Store (12-100)

755 Flashing Characteristics of Fluorescent Lamps — J. H. Campbell and D. D. Kershaw

761 Flashing Applications of Fluorescent Lamps — R. W. Bunner and R. T. Dorsey

768 Tesla — Prophet of Modern Lighting — S. G. Hibben

7A Lighting News
Scheduled Events, 35A; About People, 39A; It Seems to Me, 40A; Books and Pamphlets, 50A; New Members, 52A.

61A Index to Advertisers

Sustaining Members — Refer to September issue of ILLUMINATING ENGINEERING.

I.E.S. Committees — Refer to October issue of ILLUMINATING ENGINEERING.

STATEMENTS and opinions in articles and papers in ILLUMINATING ENGINEERING are the expressions of contributors and do not necessarily represent the policies or opinions of the Society. Official Society opinions are expressed only in official committee reports specifically approved by the Council of the Illuminating Engineering Society.

ILLUMINATING ENGINEERING SOCIETY

EDITORIAL and advertising offices
1860 Broadway, New York 23, N. Y.

PUBLICATION office 32d Street & Elm Avenue, Baltimore 11, Md.

Founded 1906

ILLUMINATING ENGINEERING: The Journal of the Illuminating Engineering Society. Copyright 1956 by the Illuminating Engineering Society. Published monthly in the United States of America. Entered as second-class matter at the Post Office, Baltimore, Md. Acceptance for mailing at special postage rates provided for in Section 1103 P.L.&R., Act of October 3, 1917. Authorized July 16, 1918. ¶ Subscription $12 per year plus extra postage to all countries to which second-class postage rates do not apply; single copies $1.00. ¶ Address changes must be received at I.E.S. headquarters by the first of the month to be effective with the issue of the next succeeding month.

HERE'S HOW THE ADVANCE SERVICE-STOCKING DISTRIBUTORS' PLAN WORKS TO BENEFIT YOU

ADVANCE TRANSFORMER COMPANY has appointed over 600 Service-Stocking Distributors throughout the United States who are participating in this nation-wide program. These authorized distributors carry a complete stock of all popular ADVANCE ballasts to give immediate replacement service for any make fluorescent lamp ballast whenever replacement is necessary. Simply bring the inoperative ballast to any ADVANCE Service-Stocking Distributor. The ADVANCE cross-reference guide shows at a glance the replacement needed, and in a few moments, you can be back on the job with the correct ballast.

All ADVANCE fluorescent lamp ballasts carry a two-year warranty and are replaced without charge. The ADVANCE label is your assurance of dependable, efficient performance at lowest cost . . . the result of years of research, engineering and development.

The ADVANCE Service-Stocking Distributor Program enables you to give better service and greater customer satisfaction.

The plan works equally well for all ballast users . . . if you are not now utilizing the ADVANCE Service-Stocking Distributors' Program, write today for complete details.

The Heart of the Lighting Industry

ADVANCE

CBM CERTIFIED

World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts

TRANSFORMER CO.

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

Curtis Color-Magic

GOLDEN ALZAK EDGE-GLO

Something New in Lighting

■ New Curtis Color-Magic Golden Alzak Edge-Glo brings a fresh beauty to traditionally colorless commercial ceilings. New Curtis Golden Alzak uses the same high purity grade aluminum as Curtis Silver Alzak, and has the same hard, transparent aluminum oxide sheath that forms the non-tarnishing, easily maintained finish that is Alzak, plus a life-time of permanent color beauty that never needs refinishing. New Curtis Color-Magic Golden Alzak Edge-Glo is available in 2, 4, and 6 lamp sizes and a variety of bottom closures for complete versatility and the finest in quality lighting, just like the Silver Alzak and white Fluracite enamel finished Edge-Glo. Send coupon for New Curtis Color-Magic Golden Alzak Edge-Glo data.

Curtis Lighting, Inc., 6135 W. 65th Street, Chicago 38, Illinois

Send Curtis Color-Magic Golden Alzak Edge-Glo data to:

Name_____

Affiliation_____

Address_____

City_____ **Zone**_____ **State**_____

CURTIS

CURTIS LIGHTING, INC., 6135 W. 65th STREET, CHICAGO 38, ILLINOIS

California, 242 S. Anderson St., Los Angeles 33, California • Canada, 195 Wicksteed Ave., Toronto 17, Canada

A Drafting Room Needs the Best Light It Can Get ...It Gets It Here with Lighting by LITECONTROL!

This large area of The Clarkeson Engineering Company, Inc., Boston has all the working light required without excess brightness at desk and drawing board level. Intensity is 61 footcandles average, a year after installation.

The two lamp louvered fixtures by Litecontrol in addition to assuring low brightness, feature trim appearance and easy installation and maintenance. Yes, and because these are *standard* fixtures, they will meet the budgetary requirements of almost any firm or company seeking quality lighting at moderate cost.

Louvers are hinged from either side for servicing without the need for tools. The frame around the louver's sides provides rigidity, eliminates sharp edges.

Next time you have a large commercial area to illuminate (or a smaller one) where you want the right amount of light in the right places — in any intensity or combination of intensities, call on Litecontrol. We have a standard fixture which will do the job — and save money in addition.

INSTALLATION: The Clarkeson Engineering Company, Inc., Boston, Massachusetts

AREA: Drafting Room

ELECTRICAL CONTRACTOR: Gaston Electric Company, Boston, Massachusetts

FIXTURES: Litecontro #5328 and #5324 2-lamp louvered fixtures, 8 ft. and 4 ft. long, pendant mounted on 18" stems.

MOUNTING HEIGHT: Approximately 9'-0"

FIXTURE SPACING: 9'-0" on centers

INTENSITY: 61 footcandles average, after one year's service

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

Goddard Trophy Established for

My Most Interesting Lighting Job Contest

A SILVER CUP trophy has been established, to be presented each year to the winner of the contest for My Most Interesting Lighting Job. It is, of course, in addition to the prize money award. The cup, of sterling silver and nine inches high, is the gift of Past-President Charles H. Goddard, shown above presenting it to President R. F. Hartenstein during the National Technical Conference in Boston September 19.

Each year's winner of the national contest, final phase of a three-part competition, will hold the cup until the next contest. Name, Section/Chapter and Region of the winner will be engraved on it after each year's contest as a permanent record. Each winner will also receive a silver miniature of the trophy as a permanent memento, along with a certificate and check for the prize money.

First recipient of the Goddard Trophy is this year's winner, William F. Jones, Southern California Section, South Pacific Coast Region. Details of Mr. Jones' winning installation are shown on the following page.

I.E.S.'s contest, widely known as "MMILJ" has for several years been a major activity locally and nationally. Starting some ten years ago as a local program of the Eastern Pennsylvania Section, the contest was soon adopted by other Sections and Chapters. In 1952 the contest was established as a national project under the direction of the Lighting Service Committee, the first National MMILJ Contest being held September, 1952 at the National Technical Conference in Chicago. Every year more and more Sections and Chapters have scheduled the MMILJ competition as one of their Section/Chapter programs, where it has become one of the highlights of their local activities.

Under current rules, local members compete within their Sections or Chapters in the presentation of their "Most Interesting Lighting Job," the winner being chosen by a neutral group of three judges. Winner of the local contest again competes at a Regional Contest, in competition with winners from other Sections and Chapters within his I.E.S. Region. This contest, usually a feature of the Regional Conference, is judged by a neutral group of five judges. From the Regional Contests have emerged ten contestants for the National MMILJ Contest, featured on the program of the National Technical Conference.

First-Prize winners of the National MMILJ Contest since its inception are:

1952 — Earl A. Domoney, Michigan Section
Great Lakes Region

1953 — Merrill R. Humber, Northern California Section
South Pacific Coast Region

1954 — Floyd Sell and Duncan Preston, Michigan Section
Great Lakes Region

1955 — George C. Schroeder, Jr., New Orleans Section
Southern Region

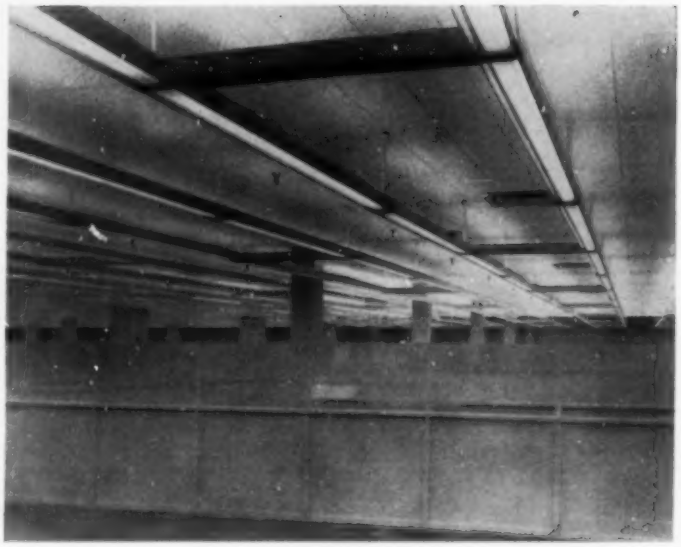
1956 — William F. Jones, Southern California Section
South Pacific Coast Region

The stature and importance to which this contest has grown well warrants the establishment of a beautiful and permanent trophy. There is no doubt but that the Goddard Trophy will be keenly contested throughout every Section and Chapter of the Society. As Mr. Hartenstein remarked in accepting the cup from Past-President Goddard, "I.E.S. appreciates the generosity which prompted this gift, but especially does it value the thoughtfulness and recognition of the potential worth of the contest to every member of the Society."

Specifications

The System installed must—

- have maintained lighting level in excess of 100 footcandles
- be inexpensive in cost of equipment and installation
- be easy to maintain
- not interfere with acoustic design of the room
- be pleasant and comfortable to work under
- not produce bright images in glossy surfaces
- be quiet in operation
- not require special fire extinction systems or high insurance rates



Luminaire Design—

By way of specifications within which their lighting system *must* fall, builders of the new Airesearch Engineering Building in Los Angeles drew up those shown in the adjoining box. Their object was to provide a very high level of light, with comfort, in an extremely large, low-ceilinged room (250 ft by 150 ft by 9 ft 6 inches). The room was to be used for engineering design and drafting.

Their stringent specifications seemed to preclude, for one reason or another, many good current lighting systems. For a system to meet many of the specifications, a semi-indirect luminaire seemed to be called for, possibly of special design to meet still further the owner's limitations. The lighting system accepted as meeting all of the rules laid down uses a luminaire whose design features were still on the drafting board at the time of the proposed installation. The original purpose of the design was to produce a unit which would give quality comparable to a luminous ceiling, at a lower cost. As shown in the picture of the ceiling, above, the subsequent design has been worked into a system which fully met or exceeded the specifications.

William F. Jones

Southern California Section

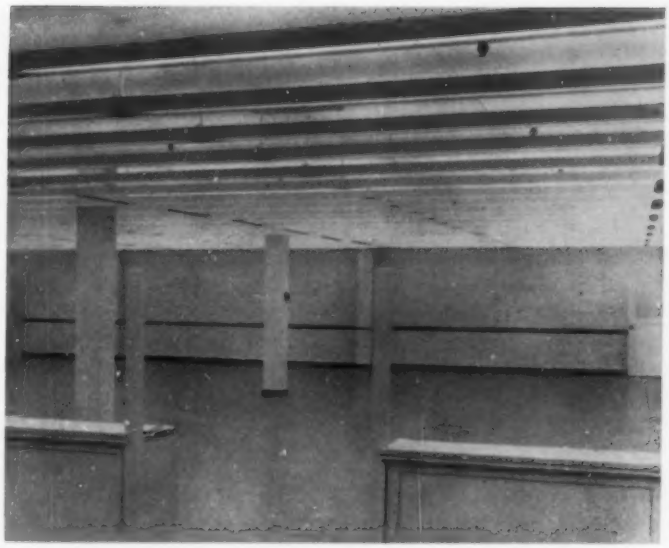
South Pacific Coast Region

Mr. Jones, designer of this first-prize winning installation is with Smoot-Holman Company, Inglewood, California.

Design

The design incorporates single-lamp 800-ma 96-inch lamps on 40-inch centers, suspended with the bottom at 8 feet 1 inch from the floor. Application data include:

Room Index — $k_r = .056$ (index of A plus)
Ceiling — 78 per cent
Wall — 60 per cent
Floor — 20 per cent
Luminaire efficiency — 78 per cent



Left: Details of the design may be seen in this view of the ceiling. Note unconventional narrow characteristic of the luminaire; ballast in cross member; sprinkler heads mounted directly above the unit.

Right: Installation viewed across the room; desks have been oriented for this position. Brightness gradation from ceiling to wall to floor has been held to the minimum possible ratio.

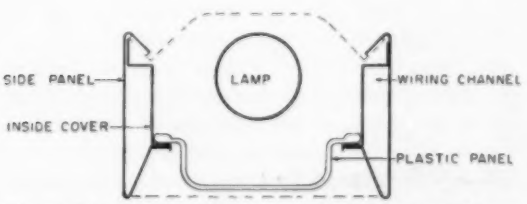
for large area, low ceiling drafting room

1st PRIZE mmilj

Coefficient of utilization — .71
Partitions, 36-inch with obscure glass to 60-in.
Calculated initial level without partitions, 173;
measured with partitions, 176.
Illumination level — 164 initial footcandles
(100-hour value).

Limitations on cost were met satisfactorily, as were all of the "rules" regarding maintenance. There are no horizontal surfaces except the bottom plastic (see drawing below), and this is readily removable for cleaning and relamping. Temperature of the lamps and ballast is kept low by separating them, with the ballast in a cross member of the luminaire. The lamps are level with the top of the luminaire, for maximum cooling.

Specifications referring to acoustics are met in the narrow characteristic of the luminaire and the vertical or near-vertical sides; there is little or no interference with sound reaching the acoustical tile ceiling. In addition, some degree of sound baffling is afforded in the crosswise direction.

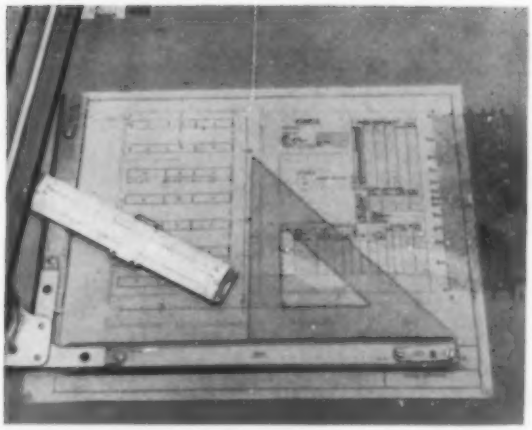


Cross-section of the luminaire. Distribution is 85% up, 15% down.

Comfort

The achievement of comfort conditions was the crucial point of the entire job. This was done by correlating all room and luminaire factors into an integrated system of brightness control. From a room standpoint, reflectances of room surfaces were selected for proper ratio balance. The ceiling is 78 per cent for high utilization; walls are purposely 60 per cent for good ceiling-to-wall ratios, and the floor of 20 per cent reflectance is a compromise between brightness ratios and ease of maintenance. Details of brightness measurements are shown in Tables I and II.

The luminaire design solved the problem of high levels of indirect lighting without high brightnesses



Typical task under this lighting system. Photometric data sheet at right has glossy surface typical of plastic-enclosed curve sheets. Note image does not obscure lettering. Triangle is typical triangle, with glossy surfaces.

TABLE I — Brightness Readings.

	Footlamberts
Overlapping fixtures (field)	97
Bottom plastic panel at 75°	210
Bottom plastic panel at 45°	430
Ceiling adjacent to fixtures	220
Ceiling between fixtures	140
Side wall half way up	45
End wall half way up	40
Floor	30

TABLE II — Brightness Ratios in Visual Field.

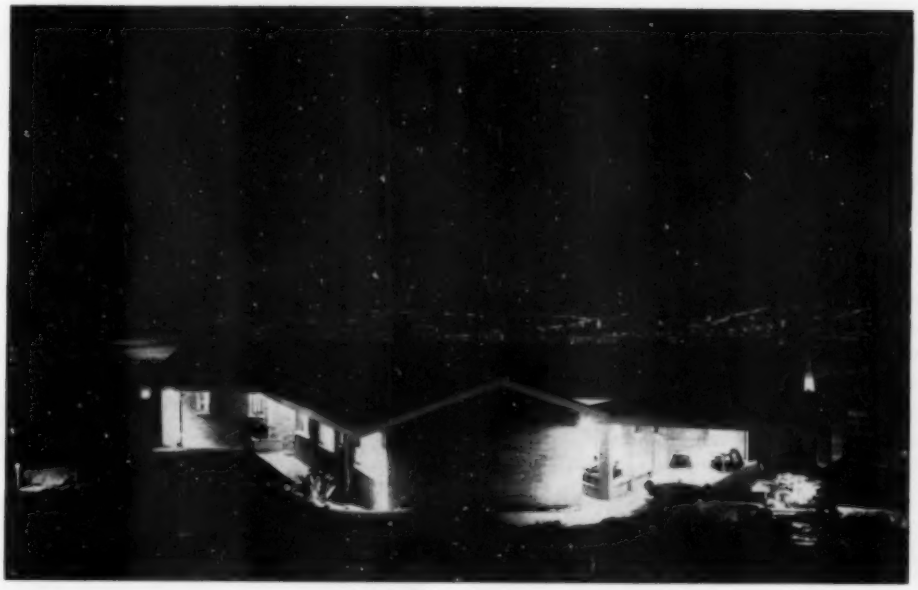
	Actual	I.E.S. Recommended
Maximum ratio for adja ent surfaces		
Bottom panel to ceiling	3.0:1	20:1
Field to side wall	2.2:1	20:1
Task to desk (80% task)	2.3:1	3:1
Ratio of brightness to adaptation level (130 ft-L)		
Field	0.75:1	0.1:1
Bottom panel at 75°	1.61:1	20:1
Bottom panel at 45°	3.30:1	20:1
Ceiling adjacent to fixture	1.69:1	10:1
Ceiling between fixtures	1.08:1	10:1
Side wall	0.35:1	0.1:1
Maximum ratio anywhere in visual field		
Field to floor	3.3:1	20:1
Bottom panel to field	4.4:1	20:1
End wall to ceiling	3.5:1	20:1

in the upper part of the room. The louvering effect of the luminaires cuts off the ceiling at angles close to the line of sight, thus eliminating ceiling brightness. This is true only of the crosswise viewing direction, but planned orientation of the desks was such as to make this the predominant viewing direction. If a random orientation were used, better conditions would be achieved by running the fixtures crosswise, as was done in an adjacent room.

By varying the plastic density, the amount of downward light was controlled to give the largest amount of direct light possible without introducing direct and reflected glare. Side panels of the luminaire were brought down below the plastic panel to shield it from view at high angles. The slender lines of the luminaire, and its wide distribution, with the resulting negligible amount of blocking of return light from the ceiling, made it possible to mount the luminaire close to the ceiling without the penalties of absorption of light by the unit, or high variation in ceiling brightness. This factor contributes to the high coefficient of utilization obtained, as well as the agreement between calculated and measured results.

Fire rating specifications, as laid down by the owner, are also met through this unconventional narrow dimension. Slimness of the unit prevents interference with the location of sprinkler heads, the fire rating bureau ruling that the luminaire is not wide enough to interfere with the action of any sprinkler. The installation fell into the lowest insurance rate bracket.

The final installed system surpassed by a wide margin all the specifications set for it, and the employees working under it also endorsed its efficacy. Of further interest is the fact that its performance was predicted with astounding accuracy by the calculations. Footcandle levels were calculated by the interflectance method as adapted by Innis, with agreement within two per cent in empty rooms. Comfort conditions were as predicted by the Guth BCD researches and the Harrison-Meaker glare rating data.



House with a View Toward Living

2nd PRIZE mmilj

Dorothy McGregor
British Columbia Section
Pacific Northwest Region

Miss McGregor is Home Lighting Consultant with the British Columbia Electric Company, Ltd., Vancouver, British Columbia.

HIGH ABOVE the city of Vancouver, B. C., and visible to most of its people, stands a house designed in every way to demonstrate the comfortable, tasteful, convenient way of modern living. Its setting is unsurpassed. Every detail of its architectural and decorative planning has been coordinated toward a happy ending. Complementing all this, giving life to its comfort, convenience and beauty, is a lighting design also coordinated from the drawing board onward.

Architect, builder, interior decorator, lighting specialist, kitchen planning advisor, electrical contractor — all concerned with its design, plotted together for its end results. Structural handicaps to the lighting could be eliminated from the first rough drawing. Colors and fabrics could be chosen, not only to enhance the decor, but also to contribute to the lighting effects. Adequate wiring, for modern electrical appliances and good lighting, was, of course, included in the design. A 200-ampere main service was used, with a low voltage system designed to give convenience in lighting control. It is of interest to note that the complete cost of the wiring, including underground wiring for garden lighting, was approximately 4 per cent of the total cost of the house.

All areas of the house, indoors and out, were in-

cluded in the lighting plan; some of these are shown in the accompanying photographs. Shown is an overall view of the home in which lighting was designed not only for display purposes, but also for family lighting. The lighting specialist, Miss Dorothy McGregor (British Columbia Electric Company, Vancouver) took as her theme in drawing up the lighting plans, the I.E.S. definition of family living — "the daily performance of many household, recreational and social activities requiring sight." With this in mind she designed the lighting of this home to provide utility lighting for work areas, comfortable lighting for recreation and amusement, and glamorous lighting for atmosphere.

Driveway and approaches to the house have been safely and attractively lighted by post light, garage lights and floods. Wall brackets and floodlights under the eaves around the entire house light steps, paths, and a garden court for safely and convenience. An illuminated number identifies the house. Garden lighting and an illuminated fish pool add to the naturally attractive setting.

First impression on entering is that of a friendly welcome. In the hall (see photograph) the warmth of the mahogany is enhanced by the star fixture, and illuminated niches may be used alone for atmosphere lighting. Halls leading to the family room and bedroom wing have an average level of 10 footcandles from semi-recessed, easy to clean luminaires.

Main hall.

In the living room (see picture) adjustable spots dramatically highlight planter and flowers, or light the music racks of the piano. The rugged cut stone end wall and mantel ornaments are also highlighted from adjustable spots. Average illumination throughout the room is 15 footcandles; well-designed table lamps provide I.E.S. recommended lighting levels for eye tasks.

These lovely surrounds are enhanced by wall to wall valance lighting. Here the draperies and the cedar ceiling finished with a white cedar stain have a reflectance of 47 per cent. Rapid-start deluxe

Living room.

Dining room.

Kitchen-breakfast room.

warm lamps bring out the warm tones of the mahogany and accentuate the pattern in the draperies. There is no uncomfortable brightness — just below the valance board the brightness is 60 ft-L, directly above on the wall, 11 ft-L, and on the ceiling above the valance board, 6 ft-L. Almost as important as the comfort, however, is the intangible element so necessary for successful home lighting — pleasure and pride in the environment.

In the dining room the center beam of the vaulted ceiling carries a track on which the fixture can be moved to center over the table in any position. Since it is a reel-type unit, the hostess may choose the desired height as well. This pierced brass fixture provides 20 ft-c on the table center and is complemented by matching double brackets over the buffet. Result—a sparkling table with softly lighted surroundings.

Pride and joy of the hostess is the well-lighted kitchen, partially seen in the photograph. Adequate general lighting has been augmented by local lighting. A light under the vent hood over the fold-away elements (not shown in the picture) gives 35 ft-c alone, and this home-maker need never work in her own shadow. Fluorescent lamps concealed under the front edge of the cupboards provide 65 ft-c on working counters having a reflectance of 43 per cent. The main fixture is a two-foot square six-lamp semi-recessed plastic shielded fluorescent unit with a brightness of 374 ft-L. Harmonizing with this is a plastic "bubble" light on reel type suspension over the breakfast bar. Over the sink on the far side of the kitchen a 75-watt recessed and louvered spot provides 35 footcandles.

Rooms not shown in the photographs were similarly planned for "the daily performance of many activities requiring sight," and for comfort, convenience and glamour. In the family room, for example, lighting for I.E.S. recommended values was provided for sewing, reading, writing, or just plain loafing. Units used include adjustable wall lamps for desk or sewing machine, and well-designed portable lamps for reading. For TV viewing, the overhead lights may be dimmed to any desired level. Bathrooms, bedrooms, two girls' rooms and two boys' rooms, all feature lighting for seeing, and for atmosphere.

Each feature of the design complements the decoration. The lighting in every phase of its use is a source of pleasure and pride to the family who now live there, and more certainly is worthy of the home's unrivalled setting.

The Light Is Right At Mutual

E. H. Schaefer
Milwaukee Section
Midwestern Region

Mr. Schaefer, who did the specifications for this installation, is Lighting Engineer with the Special Services Sales Division of the Wisconsin Electric Power Company in Milwaukee.

LIGHTING the offices and banking area of Mutual Savings and Loan Association, Milwaukee, Wis., was the second time around for lighting engineer E. H. Schaefer, vindicating his eight-year crusade to persuade the customer to good lighting principles. Back in 1947, despite his most articulate protest, Mutual had installed a bare lamp lighting system. By 1955 they were ready for I.E.S. recommended practice. Cooperation with the architect provided installations with eye comfort for employees and eye appeal for clients.

Mutual gets attention by day or night, with PAR-39 floodlighting recessed in upper and lower soffits of the exterior, and large window area revealing the highly lighted interior.

The first floor banking area has plenty of functional light combined with color and planting to give a sense of well being. The decorative pendent chandeliers add interest and something to see — both from within and from without. A fluorescent cove and incandescent downlighting, plus the chandeliers, supply 50 footcandles over the deposit slip tables in the center of the customer area.

In the officers' area four-foot plastic squares provide 80 footcandles, augmented to 125 ft-c by accent downlights at the receptionist's desk and adjacent planting.

The tellers carry on their work under lighting from fluorescent troffers with low brightness control lenses. Footcandle levels here are:

Deal plates — cashier side	160 ft-c
customer side	100 ft-c
General area lighting	140 ft-c
Card records — horizontal	170 ft-c
vertical	60 ft-c

These are maintained values taken after seven months' operation, with a Weston Model #614 meter with Viscor filter and cosine corrected diffusing disc.

Comfort of the visual environment is evidenced by these measured brightness readings:

Paper on desk top	80 ft-L
Blonde tan linoleum desk top	45 ft-L
Light tan asphalt tile floor	39 ft-L
Ceiling, line of vision	80 ft-L
Adjacent wall, green	24 ft-L
Viewed wall, yellow-green	45 ft-L

Brightness readings are also maintained values after seven months and were obtained with a Spectra Brightness Spot Meter.

The same care was taken in specifying for com-

3rd PRIZE

First floor — cashiers, public area and officers' area.

fort and function in both the public and work areas on the second floor. Here the lobby has a large area source and cove combination which supplies 75 footcandles. A troffer system similar to that in the cashiers' work area on the first floor also has the low brightness control lenses. Surface finishes, including typewriters, are light throughout.

The conference room has handsome appointments and a lighting system which complements the beauty of the room. The large-area flush-mounted source of multiple plastic squares produces 140 footcandles, or 100 or 50 on the three-way switch. The lighted cove gives the ceiling a floating appearance.

Private offices, including the president's, also use the large-area plastic-diffuser type installation with high-level illumination. Surfaces are light, again producing brightness ratios well within I.E.S. recommendations.

The lounge area for employees gives a change of pace and opportunity for relaxation with 25 footcandles from recessed incandescent lighting.

An interesting demonstration of the need for an environment in line with the high levels of illumination was experienced on the third floor of the Mutual building. This office space, lighted by the same troffer-with-lens system, was rented by a tenant who purchased dark-topped desks. Brightness contrasts produced a complaint — and the offending surface was refinished with a light-colored matte plastic covering.

The light that is right at Mutual is yet another instance of one more customer convinced by the application of good lighting principles.

Second floor — conference room.

Second floor — lobby (at rear) and office area.

The Evaluation of Discomfort Glare

By GLENN A. FRY

Numerical Assessment of the Capacity of a Single Glare Source To Produce Discomfort

THERE ARE at present at least three numerical assessments that one can apply to a glare source to express its capacity for producing discomfort.

1. The glare rating (G).[1,2]
2. The BCD index (M).[3]
3. The percentage of a sample of normal observers for whom the glare source will be comfortable. Meaker and Oetting[4,5] refer to this as the visual comfort index (VCI). Logan and Lange[6,7] refer to this as the visual comfort factor (VCF).

A given glare source in the field of view can be made comfortable by reducing the solid angle (Q) that it subtends at the eye. If we designate by $\overline{Q}$ the average value of Q for a sample of normal observers at which the glare source reaches the border between comfort and discomfort, we can define the glare rating (G) as follows:

$$G = 55.6 \frac{Q}{\overline{Q}} \tag{1}$$

The same glare source can also be made comfortable by reducing its brightness (B). If we designate by $\overline{B}$ the average brightness at which it reaches the borderline between comfort and discomfort for a sample of normal observers, we can define the BCD index (M) as follows:

$$M = 108 \frac{B}{\overline{B}} \tag{2}$$

Luckiesh and Guth[3] have determined the BCD brightnesses for a sample of fifty normal observers using a glare source placed on the line of sight and subtending a solid angle of 0.0011 steradian at the eye and having a background brightness of 10 footlamberts. From this data, one can compute the geometric mean of the BCD brightnesses. This was found to be 830 footlamberts.

Furthermore, for each value of B (*i.e.*, for each value of M) one can compute the percentage of persons who do not experience discomfort.[3,8] See Fig. 1. This gives a rational meaning to the BCD scale.

Luckiesh and Guth also determined the geometric mean of the BCD brightness for $S = 10$ footlamberts and for various values of Q between 0.0001 and 0.126 steradian and found that

$$B = 296\, Q^{-0.21} - 377. \tag{3}$$

From this equation one can compute the value of $\overline{Q}$ for any brightness level of the glare source, and hence for any value of M, one can compute the corresponding value of G. (See Fig. 2.). A graphical analysis of this relationship is shown in Fig. 3. For any value of G one can compute the percentage of people who would experience discomfort. See Fig. 4. Although for this particular combination of values of B, P and S ($B = 830$ footlamberts; $P = 1$; $S = 10$ footlamberts) one can assume a fixed relation between G and the percentage of persons reporting discomfort, it might be questioned whether this holds for other values of B, P and S.

If one could assume that the amount of discomfort is proportional to area, it could be deduced from this that the relation between G and VCI remains constant for various values of B, P and S. By the same token, the relation between VCI and M need not be constant for different values of Q, P and S.

Equations for $\overline{Q}$ for Single Glare Sources

The value of $\overline{Q}$ will depend upon the background brightness (S), the brightness (B) of the glare source, its direction in the field of view, and according to Harrison and Meaker the value of $\overline{Q}$ will also depend upon the brightness (R) of the immediate background. The direction of a glare source in the field of view can be designated in terms of H, W and Y as shown in Fig. 5.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 17-21, 1956, Boston, Mass. AUTHOR: School of Optometry, Ohio State University, Columbus, Ohio.

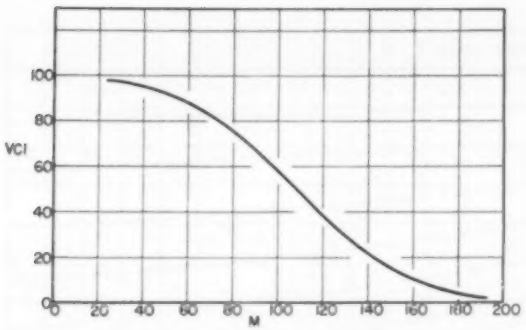


Figure 1. (Above). Relation of VCI (Percentage of observers who are comfortable) to *M*.

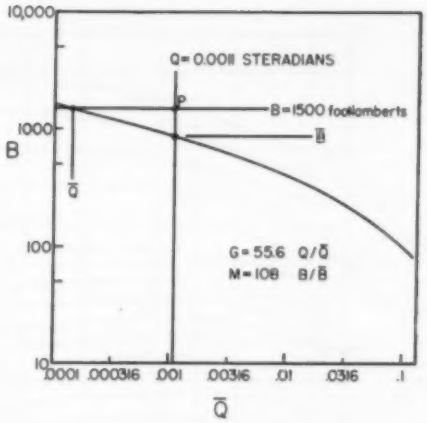


Figure 2. (Right). Relation between *G* and *M* for a given stimulus *P*.

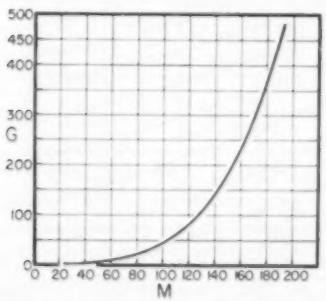


Figure 3. (Left). Relation between *G* and *M*.

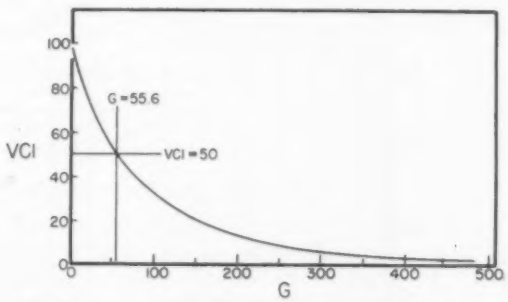


Figure 4. (Right). Relation of VCI to *G*.

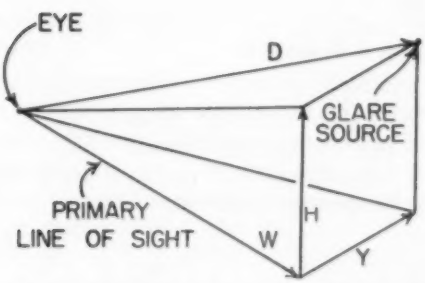


Figure 5. (Above). Method of specifying the direction of a glare source in the field of view.

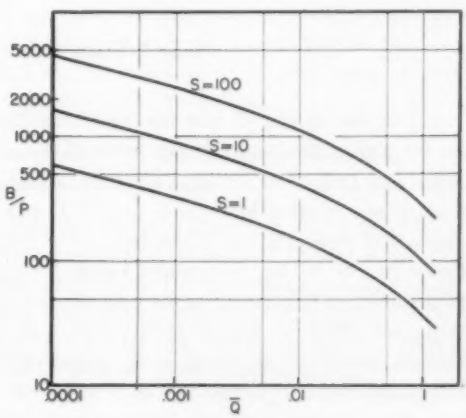


Figure 6. (Right). Relation of Q to B/P and S according to Luckiesh and Guth.

Luckiesh and Guth have derived from their BCD data the following equation relating $\overline{Q}$ to P, B and S:

$$\overline{Q} = \left[\frac{1}{108} \left(\frac{B}{P \cdot S^{0.44}} \right) + 1.28 \right]^{-4.76} \qquad (4)$$

In Fig. 6 various values of $\overline{Q}$ are plotted for various values of B/P and S. Since in their experiments the glare source was always presented on a uniform field, S was equal to R and hence it was not necessary for R to be included in the equation. P is a function of H/W and Y/W and the value of P can be obtained from the graph in Fig. 7, which Luckiesh and Guth have derived from BCD data using peripheral glare sources. In computing the $\overline{Q}$ value of a glare source in a lighted interior Guth[9]

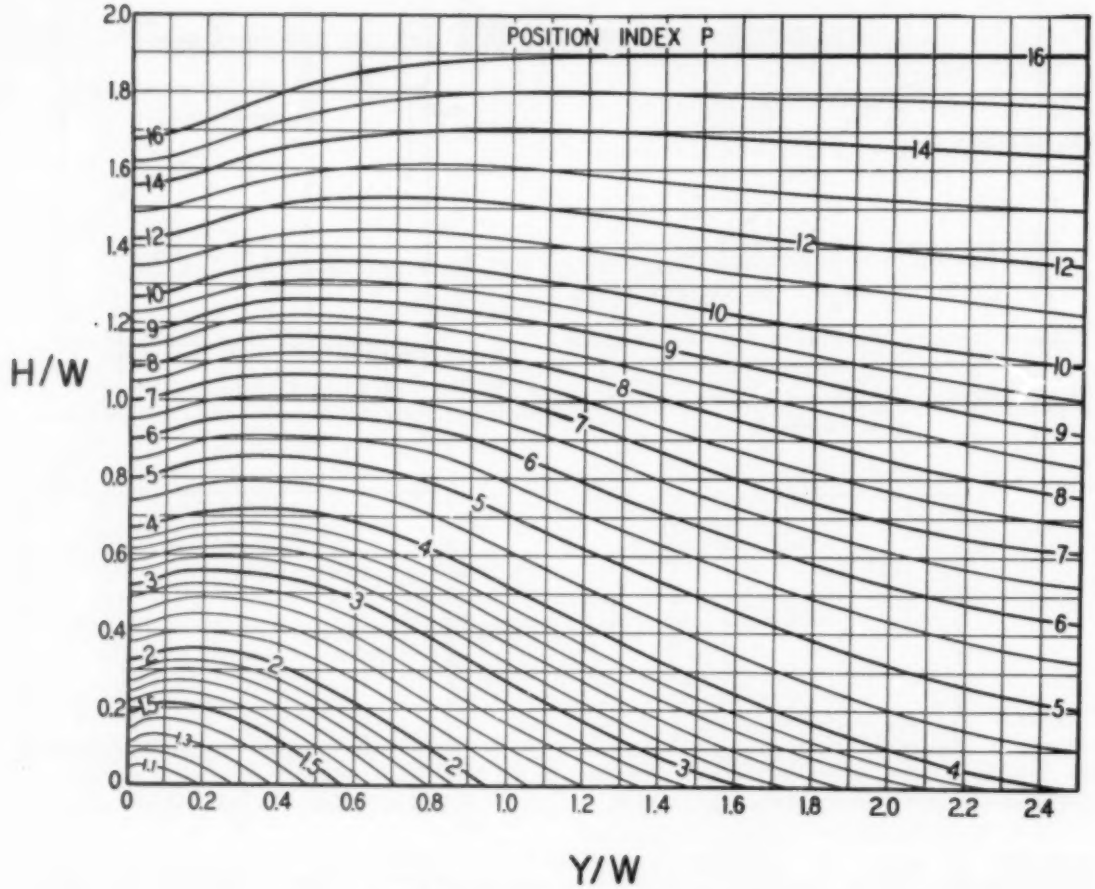


Figure 7. Graph for determining P from H/W and Y/W.

has used in one of his studies the wall brightness at the far end of the room for the value of S.

Logan and Lange[6] do not have a general equation expressing the relation between Q and P, B and S, but represent this relation in the form of a graph as shown in Fig. 8. For Logan and Lange S represents the average brightness in the field of view and no separate effect of the brightness (R) of the immediate surround is taken into consideration. The Luckiesh-Guth P values in Fig. 7 are used.

According to Harrison and Meaker[1,2] the glare rating of a source is given by

$$G = \frac{10^{-6} \cdot A \cdot B^2 \cdot L}{H^2 \cdot F} \qquad (5)$$

where

A = projected area of the source in square inches,
H = height of the glare source above eye level,
B = the brightness of the source,
$F = (S/10)^{0.6}$ when $R = S$,
$F = (S/10)^{0.6} \log 10R/S$ when $R > S$,
$F = (S/10)^{0.6} \log 10S/S$ when $S > R$,
L = a function of W/H and Y/H and is called the *location coefficient*,

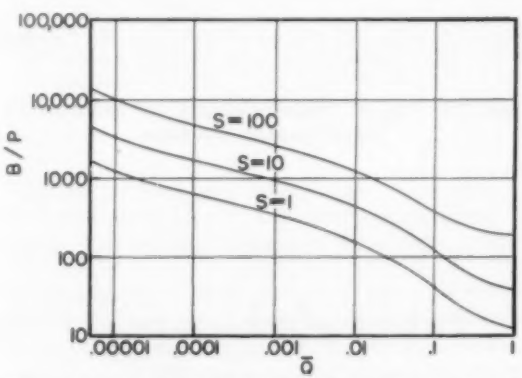


Figure 8. Relation Q to B/P and S according to Logan and Lange.

W = the distance from the eye to the frontal plane through the glare source in feet, and
Y = the lateral displacement from the median plane in feet.

Fig. 5 shows the relations between W, Y, H, D, A and Q. For the special case in which $R = S$

$$G = \frac{10^{-5.4} \cdot A \cdot B^2 \cdot L}{S^{0.6} H^2} \tag{6}$$

Since

$$A = 144\, Q D^2 = 144\, Q\, (Y^2 + W^2 + H^2),$$

$$G = (144)\,(10^{-5.4}) \left(\frac{Q B^2}{S^{0.6}}\right) L \left(\frac{Y^2}{H^2} + \frac{W^2}{H^2} + 1\right). \tag{7}$$

If we let P represent a function of Y/H and W/H which is defined as follows

$$P^2 = \frac{220}{L\left(\frac{Y^2}{H^2} + \frac{W^2}{H^2} + 1\right)}, \tag{8}$$

$$G = \frac{0.126\, Q B^2}{S^{0.6} P^2}. \tag{9}$$

It follows from this equation that if a source has a brightness of 1000 footlamberts, an area of one square inch, an S value of 10 footlamberts and has a G value of unity when it is located 10° above the line of sight, it must have an L value of 3.02.

The constant, 220, in Equation (8) has been selected because it gives P a value of 1.48 for a glare source located 10° above the line of sight. This value of P is identical with that given by Luckiesh and Guth.

Also in accordance with what Luckiesh and Guth have found, it may be assumed that P has a value of unity when the glare source is located on the line of sight.

When Q is at the border line between comfort and discomfort

$$Q = \overline{Q}$$

and the value of G is a constant. The value of G at BCD can be determined from the finding of Luckiesh and Guth that a source on the line of sight having a uniform background of 10 footlamberts and a brightness of 296 footlamberts lies at the BCD when $Q = \overline{Q} = 0.02$ steradian. Hence at BCD

$$G = \frac{(0.126)\,(0.02)\,(296)^2}{10^{0.6}} = 55.6. \tag{10}$$

If G at $BCD = 55.6$, it follows from Equation (9) that

$$\overline{Q} = \frac{440\, P^2\, S^{0.6}}{B^2}. \tag{11}$$

Fig. 9 shows a plot of $\overline{Q}$ against B/P for various values of S when $S = R$. This is based on Equation (11).

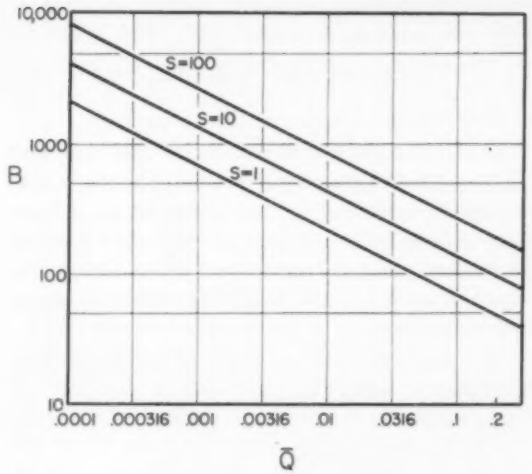


Figure 9. Relation of Q to B/P and S according to Harrison and Meaker.

Equation (1) is an equation for G in terms of Q and $\overline{Q}$. This equation is derived by multiplying Equation (9) by Equation (11). Harrison and Meaker recommended that the value of S be determined by measuring vertical footcandles at the eye with a General Electric light meter and multiplying by 1.25 to convert to equivalent footlamberts. Meaker and Oetting[4] are now recommending that the wall brightness at the far end of the room be used as the value of S in predetermining the G value for a lighting design.

Comparison of the Adopted Relations Between $\overline{Q}$, B/P and S

One can see from Figs. 6, 8 and 9 the comparison of the relations between $\overline{Q}$, B/P and S, which have been adopted by Luckiesh-Guth, Logan-Lange and Harrison-Meaker. The BCD curves for $S = 10$ footlamberts in Figs. 6 and 9 are tangent to each other in the region of $Q = 0.02$ steradian.

Computation of G for a Single Source

One can use a graph like any of those shown in Figs. 6, 8 and 9 to determine the value of $\overline{Q}$ for a given source and then use Equation (1) to compute G. It is obvious that the three graphs will not yield identical values of $\overline{Q}$ and G for all values of B/P and S.

Glare Rating of a Combination of Glare Sources

Harrison and Meaker determine the glare rating

of a combination of glare sources in accordance with the following formula:

$$G = G_1 + G_2 + \ldots + G_n \qquad (12)$$

This formula is based on two assumptions.

(1) If two glare sources have the same values of B/P and S, the discomfort produced by the combination is equivalent to that produced by a third glare source which has the same B/P and S values as the first two glare sources and which has an area equal to the sum of the areas of the first and second sources.

(2) Two glare sources which have different combinations of values for B/P and Q but have the same values for G and S possess the same capacity for producing discomfort.

In computing the glare rating for a given environment, Harrison and Meaker considered only those bright areas in the field of view which constitute glare sources. Logan and Lange do the same thing in practice, but if their basic principles were adhered to, each bright area in the field of view would be taken into consideration.

The Logan-Lange method of evaluating the glare produced by a multiple number of sources conforms for the most part to the Harrison-Meaker principle of adding glare ratings. As a matter of fact the only departure from the principle makes the method inconsistent with itself and when this inconsistency is eliminated, the Logan-Lange method becomes identical with the Harrison-Meaker method.

Fig. 10 illustrates the Logan-Lange method of evaluating the glare produced by a combination of two stimuli 1 and 2 which exist in an environment which has an S value of 10 footlamberts. The two stimuli are located on the graph which is a plot of BCD curves for various values of the background brightness (S). Logan and Lange then select a reference level of B/P, say 200 footlamberts at which they select stimuli 3 and 4 as equivalent to 1 and 2. Stimulus 3 lies on the same BCD curve as 1 and 4 on the same BCD curve as 2. It is then proposed that the combination of 1 and 2 is equivalent to the combination of 3 and 4. Since 3 and 4 have the same brightness it is proposed that the combination is equal to a stimulus (5) having the same brightness but an area Q_5 equal to $Q_3 + Q_4$.

This last step involves the assumption that the capacity of a stimulus to produce discomfort is proportional to its area.

The first step, namely that (1) is equivalent to (3) and that (4) is equivalent to (2) violates the fundamental principle that the capacity of a glare source to produce discomfort is proportional to its area. Stimuli 6, 7 and 8 are equivalent because they lie on the BCD curve but in order for 1 to be equivalent to 3, 1 would have to be displaced from 7 the same distance that 3 is displaced from 8. This is not the case, because the different BCD curves are not curves of the same form which are displaced laterally from each other.

In order to conform to the principle that glare is proportional to the area, one would have to proceed as follows: Let us assume that 1 and 2 exist in an environment in which the value of S is 10 footlamberts as shown in Fig. 11. By definition 6, 7 and 8 are equivalent because all these are at BCD. In order for 3 to be equivalent to 1, it would be necessary for 3 to be displaced as far from 8 as 1 is from 7 and in order for 4 to be equivalent to 2, it would have to be displaced as far from 8 as 2 is from 6. Then one could say that the combination of 3 and 4 is equivalent to 5, where $Q_5 = Q_4 + Q_3$.

In accordance with the principle of additivity of

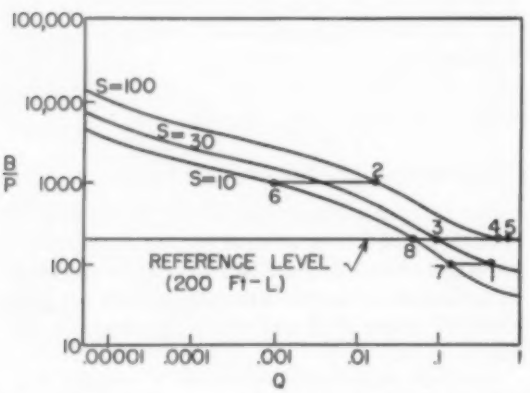


Figure 10. The Logan and Lange method of evaluating the combined glare from two sources, 1 and 2.

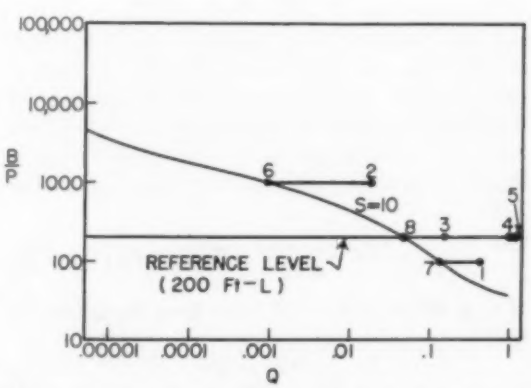


Figure 11. The Harrison-Meaker method of evaluating the combined glare from two sources, 1 and 2.

areas one can say that the capacity (G) of a stimulus to produce discomfort is given by this equation.

$$G = k\frac{Q}{\bar{Q}}$$

where k is a constant and $\bar{Q}$ is the BCD value of Q for a stimulus of a given brightness. In this equation G represents the Harrison-Meaker glare rating provided

$$k = 55.6.$$

It should be noted that

$$G_5 = k\frac{Q_5}{Q_8} = k\frac{Q_3+Q_4}{Q_8} = k\frac{Q_3}{Q_8} + k\frac{Q_4}{Q_8} = G_3 + G_4.$$

Furthermore

$$G_3 = k\frac{Q_3}{Q_8} = k\frac{Q_1}{Q_7} = G_1$$

and

$$G_4 = k\frac{Q_4}{Q_8} = k\frac{Q_2}{Q_6} = G_2.$$

Hence

$$G_{(1+2)} = G_1 + G_2 = k\frac{Q_1}{Q_7} + k\frac{Q_2}{Q_6}.$$

It follows therefore that for an environment containing any number of glare sources the value of G/k for the combination of glare sources is given by the following equation

$$G/k = \frac{Q_1}{Q_1} + \frac{Q_2}{Q_2} + \ldots + \frac{Q_n}{Q_n}. \qquad (13)$$

It should be noted that the value of G/k can be computed without using any reference level.

Although there is considerable amount of experimental evidence in support[3,10,11] of the principle of additivity of glare ratings, there are also instances[3,10,12] in which the experimental data diverge significantly from the additivity principle.

Guth[12] has submitted the following proposal for evaluating a multiple number of glare sources

$$G/k = \left[\left(\frac{Q_1}{\bar{Q}_1}\right)^{0.5} + \left(\frac{Q_2}{\bar{Q}_2}\right)^{0.5} + \ldots \left(\frac{Q_n}{\bar{Q}_n}\right)^{0.5}\right]^2 \qquad (14)$$

where the symbols have the same significance as in previous parts of this paper. For a single source

$$G/k = [(Q/\bar{Q})^{0.5}]^2 = Q/\bar{Q}. \qquad (15)$$

Although Equation (14) may apply when the sources are widely scattered in the field of view, it cannot apply to a bright area which is subdivided into smaller areas such that

$$Q = Q_1 + Q_2 + \ldots Q_n.$$

If the area is treated as a single source

$$G/k = (1/\bar{Q})\,(Q^{0.5})^2$$

and if subdivisions are treated as separate sources Equation (14) reduces to

$$G/k = (1/\bar{Q})\,(Q_1^{0.5} + Q_2^{0.5} + \ldots + Q_n^{0.5})^2$$

but

$$Q^{0.5} \text{ is not equal to } (Q_1^{0.5} + Q_2^{0.5} + \ldots + Q_n^{0.5}).$$

It follows from the same argument that whatever equation is used to compute G for a multiple number of sources must reduce to Equation (13) when applied to a cluster of contiguous areas of the same brightness.

The effects obtained with a combination of sources widely scattered in the field of view, must be handled by treating P for each source as a function not only of its position in the field of view but of the distribution of other sources in the field of view and their sizes, configurations, orientations and brightnesses.

There is also a certain amount of theoretical basis for the additivity principle.[12] On the assumption that the discomfort from glaring sources arises from pupil constriction and tension in the muscles that close and open the lids and wrinkle the skin of the forehead, it is roughly true that the amount of response is proportional to the area of the retina stimulated. There is even summation of the effects initiated in the two retinas. The problem, however, is complicated by stray light in the eye and varying sensitivities of the different parts of the retina. The problem is further complicated by the nonuniformity in the distribution of ganglion cells, bipolars, rods and cones over the retina.

It follows therefore that the use of the additivity principle for evaluating the glare produced by a number of sources must be regarded as yielding only an approximate answer.

Summary

The relationship between the glare rating and BCD index of a source has been explained as well as the method of computing one from the other and relating each to the percentage of comfortable people.

The relation of the position index P of Luckiesh and Guth to the location coefficient L of Harrison and Meaker has been explained, and the equations relating the several variables to the border line between comfort and discomfort are shown to be basically akin. The differences in exponents, coefficients and position indices are the principal differences. There is also disagreement as to how the surround brightness should be assessed, and as to what allowance if any should be made for the brightness of the immediate background.

The Logan-Lange method of evaluating a mul-

tiple number of glare sources if modified to make it self-consistent becomes identical with the Harrison-Meaker method. Although the additivity principle of Harrison and Meaker does not encompass all of the experimental facts and also has certain theoretical limitations, it still may be regarded as a usable approximation.

References

1. Harrison, Ward, and Meaker, Phelps: "Further Data on Glare Ratings," ILLUMINATING ENGINEERING, Vol. XLII, p. 153 (1947).
2. Harrison, Ward, and Meaker, Phelps: "Glare Factors and Their Significance," *General Electric Review*, 50, p. 31 (August 1947).
3. Luckiesh, Matthew, and Guth, S. K.: "Brightness in Visual Field at Borderline Between Comfort and Discomfort (BCD)," ILLUMINATING ENGINEERING, Vol. XLIV, p. 650 (1949).
4. Meaker, Phelps: "Discomfort Glare and Glare Factor Calculations," (unpublished manuscript).
5. Meaker, Phelps, and Oetting, R. L.: "Visual Comfort Index and Tables — Their Meaning and Use in Lighting Design," *Bulletin LS-108*, Lamp Division, General Electric Co., Cleveland, October 1953.
6. Logan, H. L., and Lange, A. W.: "The Evaluation of Visual Comfort Data," ILLUMINATING ENGINEERING, Vol. XLVII, p. 195 (1952).
7. "Visual Comfort Tables," Department of Applied Research, Holophane Co., New York, January 1954.
8. Guth, Sylvester K.: "Brightness Ratings in Lighting Practice," ILLUMINATING ENGINEERING, Vol. XLVII, p. 184 (1952).
9. Guth, S. K.: "Comfortable Brightness Relationships for Critical and Casual Seeing," ILLUMINATING ENGINEERING, Vol. XLVI, p. 65 (February 1951).
10. Petherbridge, P., and Hopkinson, R. G.: "Discomfort Glare and the Lighting of Buildings," *Transactions of the Illuminating Engineering Society (London)*, 15, p. 39 (1950).
11. Meaker, Phelps: "Brightness vs. Area in the Glare Factor Formula," ILLUMINATING ENGINEERING, Vol. XLIV, p. 401 (1949).
12. Guth, S. K.: "Subjective Additivity of Areas of Brightness," Presented at the International Commission of Illumination, Zurich, June 1955.
13. Fugate, J. M., and Fry, G. A.: "Relation of Changes in Pupil Size to Visual Discomfort," ILLUMINATING ENGINEERING, Vol. LI, p. 537 (1956).

Discussion of Conference Papers

Written discussion on any of the technical papers presented at the National Technical Conference should be submitted immediately for publication with the paper in ILLUMINATING ENGINEERING.

Send: One copy (original) to Miss Ruby Redford, Editor, ILLUMINATING ENGINEERING, 1860 Broadway, New York 23, N. Y.

One copy to author of the paper.

One copy to Discussion Organizer of the session.

One copy to H. F. Davidson, Chairman, I.E.S. Papers Committee, Hydro-Electric Power Commission of Ontario, 620 University Ave., Toronto, Ont.

INSTALLATION AT MODERN BRIDES SHOPPE,
533 SOUTH ST., PHILADELPHIA, PA.

Lighting for a Modeling Platform

LIGHTING OBJECTIVE: To provide a high level of accent lighting on a modeling platform.

GENERAL INFORMATION: This store, which merchandises bridal and formal apparel, measures 12 feet by 42 feet 6 inches. The ceiling height is 10 feet 8 inches. The modeling area shown above is approximately 8 feet by 12 feet. Colors and reflectances are as follows:

	Color	Reflectance
Ceiling	Light Green	72%
Walls	Light Green	63%
Wood Trim	Natural Finish Light Oak	55%
Curtains	Dark Green	11%
Seat Tops	Dark Green	9%
Floor	Grey Tone Salt & Pepper	19%

(over)

A.I.A. File No. 31

INSTALLATION: In this modeling area, general illumination is provided by one 4-foot by 4-foot surface-mounted luminaire, William Penn catalog No. 121-840, with a Plexiglas diffusing bottom. This unit is equipped with eight 40-watt T-12 standard cool white rapid start fluorescent lamps operated at 430 ma. Accent lighting is provided by nine Swivelier catalog No. B81 canopy shade units, five using 150-watt R-40 reflector spot lamps and four using 150-watt R-40 reflector flood lamps. The illumination after 600 burning hours was 250 footcandles. Brightnesses at that time were as follows:

Fluorescent Luminaire	
at 45°	750 ft-L
at 15°	582 ft-L
Ceiling	57 ft-L
Walls	69 ft-L
Wood Trim	63 ft-L
Curtains	14 ft-L
Seat Tops	9 ft-L
Floor	42 ft-L

Lighting designed by Leo D. Fadden, Lighting Engineer, Philadelphia Electric Co., Philadelphia, Pa.; Interior Decoration, Mrs. H. R. Jerkins, 2361 North 21st St., Philadelphia, Pa.; Electrical Contractor, C. Trauss, 609 East Wyoming Ave., Philadelphia, Pa.; Owner, H. F. Fine, 533 South St., Philadelphia, Pa.

Lighting data submitted by George T. Anderson, Jr., Lighting Engineer, Philadelphia Electric Co., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Plastics In Lighting

By W. E. BROWN
P. C. WOODLAND
R. J. LEE

Plastics are unique materials in every sense. They have been variously described by consumers as miracle materials or substitutes for something better. To top it off, popular concept has us living in the "plastics age." More than a few people, displeased with inferior performance of some plastics articles, have wished that the "plastics age" had never come. Nonetheless, through education and product evaluation, many misapplications and/or poor designs are giving way to the enlightened approach of the engineer. This article is intended to show the way toward effective use of the advantages plastics have to offer in fluorescent lighting.

SEVERAL YEARS ago imaginations were stimulated by the potential which plastics appeared to have in the lighting field. Plastics could be formed and colored for function and beauty. Transmission, diffusion, reflection and refraction could be balanced to suit the individual needs of any lighted area. In brief, plastics meant a new source for light control.

Thus, shortly after the first commercial advent of fluorescent lamps in 1938, plastics moved into the light control field. This turned out to be a rather premature step, since plastics at that time were not yet ready to provide the long trouble-free life of which the light source itself was capable.

Problems arose — major among these was lack of dimensional stability. Plastic diffusers, which were intended to replace glass, not only warped and distorted but in some cases actually fell out of the fixtures. Warping was blamed on moisture pickup and heat distortion. Certain materials mixed with the plastics to take further advantage of formability slowly evaporated and, at least in part, caused shrinkage.

New materials soon developed which had sufficient water and heat resistance to eliminate much of the dimensional stability problem. Likewise, most of these plastics were available in transparent and colored forms so that a wide range of transmission, diffusion, and hiding power combinations could be manufactured. Only two shortcomings stood in the way of furthering the use of plastics in lighting — high cost in one case and inadequate strength and permanence in the other.

As the industry began to adjust its thinking to lighting requirements, it became evident that some interaction between the plastics industry and lighting people would be quite desirable. Steps were taken in 1947 to organize a joint industry committee. Representatives were called together and a program was laid out. At that time the major aim seemed to be a source of information on plastics that could be used principally in two places: a Society of the Plastics Industry publication and the Illuminating Engineering Society's handbook.

AUTHORS: Plastics Technical Service, The Dow Chemical Co., Midland, Mich.

Six phases of the problem were to be covered; including average exposure conditions which plastics might encounter in lighting, compiling of acceptable test procedures, specifications for plastic materials, descriptions of plastics pertinent to fluorescent lighting, discussions of fabrication limits, and the advantages and limitations of plastics.

Unquestionably the committee had organized a very ambitious program. Perhaps this is the reason that it could not be brought to a successful conclusion.

"Plastics for Lighting" Committee

Regardless of the cause, inactivation of the joint committee postponed standardization work of this type between plastics and lighting people. On the other hand, plastics continued to be used in ever increasing amounts for diffusion of fluorescent light. Some of the old problems continued to exist, but on a larger scale. The picture was further complicated by two significant developments that had reached major proportions by 1954. First, several different types and colors of fluorescent lamps had been made available and, second, plastics manufacturers were attempting to satisfy the demand for a great variety of diffusing colors. Again, awareness of the need for education and standardization developed, and early in 1954 the joint Plastics-Lighting Committee was reactivated.

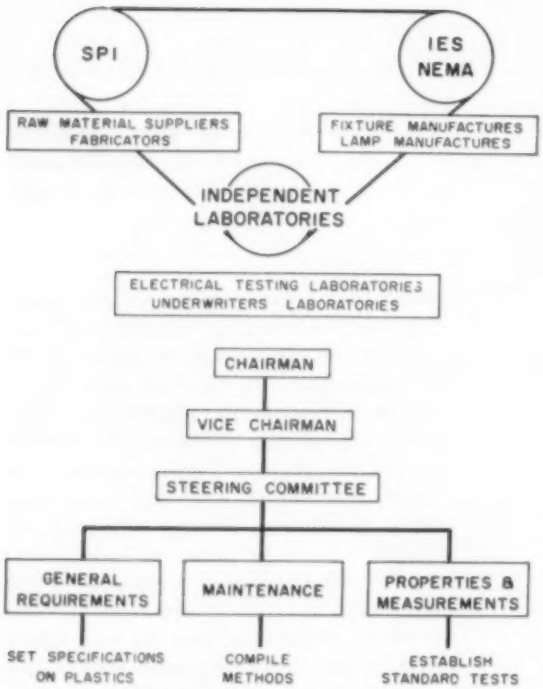


Figure 1. Organization of the Joint SPI-IES-NEMA Plastics for Lighting Committee.

Membership is similar to that of the earlier committee but organization and objectives have been modified to suit the present needs and to make the overall aim of education easier. A steering committee made up of lighting, plastics, and laboratory representatives will determine policy, scope and direction in which standardization work can be accomplished. Membership in the three operating subcommittees is divided so that the interests of each industry will be considered.

The primary goal will be to compile standards on plastics applied to fluorescent lighting. Eventually these standards will be submitted to the proper agency for industry-wide adoption. A labeling program will be developed with the Electrical Testing Laboratories and, as a final step, advertising and publicity material will be evolved.

Plastics Classification

Fundamentally, plastics are divided into two broad classifications: thermosetting and thermoplastic. The thermosets are softened by the initial application of heat, but further heating causes a chemical reaction called "curing" which hardens the material permanently, making remolding impossible. Thermoplastics are also softened by heat, but in contrast to thermosets, they are hardened by cooling below the heat distortion temperature. Remolding of thermoplastics is possible but must be undertaken with care, since prolonged or repeated heating may alter certain important properties.

As one might expect from these basic characteristics, different methods of fabrication must be used. Methods common to thermoplastics fabrication include calendering, extrusion, hot forming and injection molding — all of which are used to produce light diffusing parts.

Thermoplastics

Calendering is a high speed continuous method of manufacturing thermoplastic sheet and film. (Fig. 2) Milling the plastic under the action of heat for sufficient time produces a continuous thick sheet. A series of heavy and highly polished calendering rolls then reduces the material to a thin, smooth-surfaced sheet or film. Quite often it is desirable to put a design on the sheet while it is still warm and soft; thus, embossing equipment may be operated in series with the calendering unit.

Extrusion is still another commonly used process for continuously forming lighting parts. (Fig. 3) A screw rotating in a heating cylinder forwards the granules of material through heating zones of increasing temperature, thus forcing the hot plastic through a die of the proper shape. Cooling below the heat distortion temperature followed by coiling or cutting to the required length constitute the finishing operations. Only the designer's imagina-

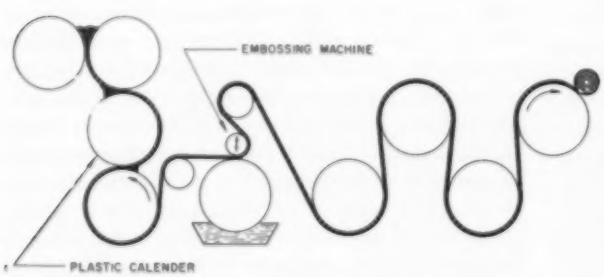


Figure 2. Plastic calender and embossing machine.

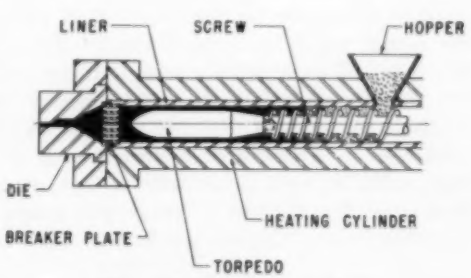


Figure 3. Plastics extruder.

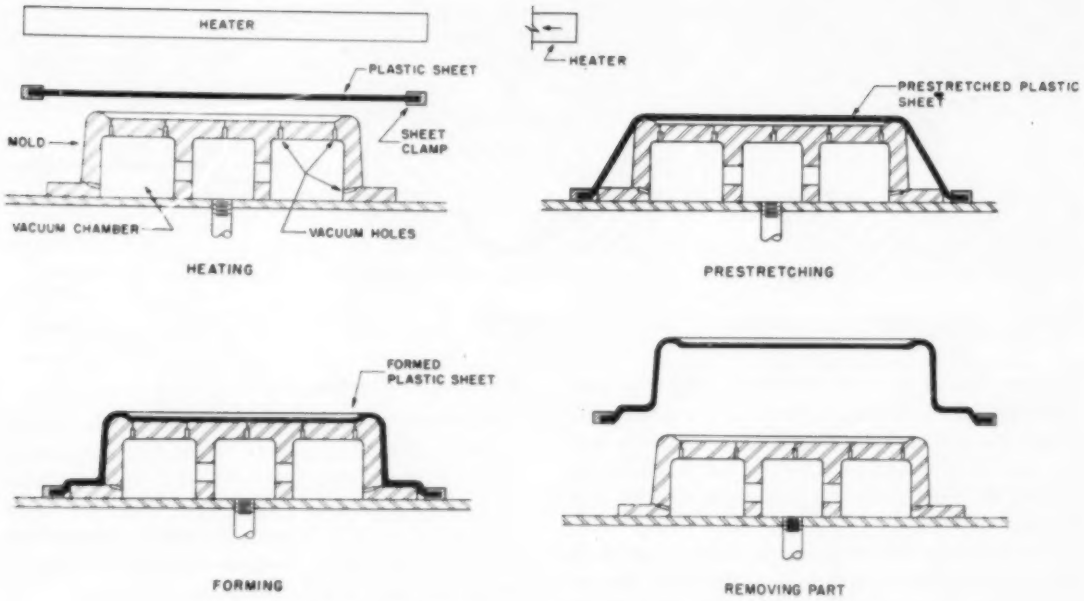


Figure 4. Drape forming — heating, prestretching, forming, removing.

tion and the engineer's skill limit the variety of shapes that may be made by extrusion.

Several varieties of what may be called "hot forming" are in common use today. For this reason a description of only one of the popular hot forming methods, drape forming, will be undertaken here. The process (Fig. 4) consists of clamping a thermoplastic sheet in a frame and heating it until it has become soft. Then it is lowered and allowed to drape over the mold. A vacuum drawn rapidly through the mold allows the atmospheric pressure to force the plastic sheet into the mold. This unique method has several advantages including fast cycles, detailed reproduction of the mold and low mold cost.

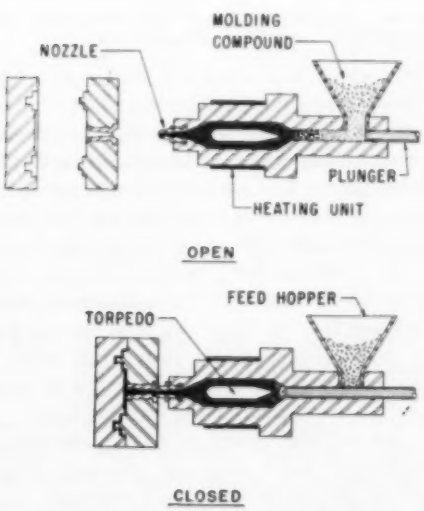


Figure 5. Process of injection mol[illegible]ng.

Many principles of injection molding have been borrowed from the older process of die casting metals. Thus, granular plastic (Fig. 5) is fed into the heating cylinder from a hopper. The matched metal molds are closed and a plunger is brought forward in the heating cylinder as in the die casting process. Hot plastic is forced into the mold, allowed to cool below its heat distortion temperature and then removed from the mold. Injection molding offers high speed production and intricate parts with good surface finish.

So far we have seen how thermoplastics are softened with heat and shaped by rolling, squeezing, injecting or otherwise pressing the plastic followed by cooling to produce finished parts. In contrast, thermosets must be shaped by curing through the application of heat or pressure or reaction with chemicals added to the plastic compound.

Thermosets

Compression molding (Fig. 6) is one of the oldest and most commonly used methods of forming plastics, particularly the thermosets Raw material is piled high in the matched metal mold cavity and heated until soft. Then the mold is closed and the material squeezed under high pressure while the

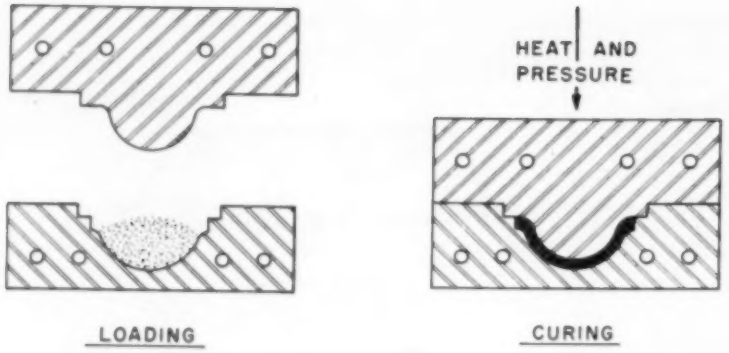


Figure 6. Compression molding.

mold is heated by hot circulating fluid or some other means. The proper balance of pressure and heat form and cure the plastic to a rigid state with the desired properties. There is no provision for cooling the mold since it is not necessary with thermosets.

Low pressure laminating is the most recent of the six methods used to produce light diffusers. Several variations can be used. However, the general method is to impregnate glass cloth or mattes of glass fibers with liquid polyester resin, following this with a curing cycle at atmospheric or low pressure. External heat may or may not be required. Plastics of this type most often appear in structural work and in glazing for light control.

Light Control Plastics

Only those plastics of practical significance in the current fluorescent lighting field will be considered here. These include:

Thermoplastics
Polystyrene
General Purpose
Light Stabilized
Polymethylmethacrylate ("Methacrylate")
Polyvinyl Chloride (PVC or "Vinyl")

Thermosets
Polyester (usually glass reinforced)
Urea Formaldehyde ("Urea")

There are of course many producers of most light control plastics. Listings, including trade names, may be found in publications by the Manufacturing Chemists Association (III) and the Plastics Catalog Corporation (III).

Properties of Light Control Plastics

Physical strength, permanence, thermal stability, heat resistance, optical characteristics, dimensional stability, thermal expansion and chemical resistance are the properties most important to the lighting designer and architect (see Table I).

Physical Properties

Physical properties of interest include weight per unit volume, resistance to impact, and elongation or extensibility. Plastics have a decided advantage compared with glass since they are much lighter per unit of volume, generally possess high resistance to impact loading and are capable of accepting moderate loads without breaking.

Permanence

Permanence here refers to resistance to water absorption and the ability to maintain original visual appearance as well as physical properties upon outdoor weathering. Again plastics compare favorably with other engineering materials in that they do not absorb significant amounts of water nor do they corrode when exposed to water or moist atmospheres. Conversely few plastics fully retain their physical and optical properties during extended outdoor exposures. Fortunately, these few have found fairly common use where plastics have been desired for outdoor applications.

Flammability and Heat Resistance

There has existed for some time a general fear that plastics present fire hazards. Part of this fear can be traced to cellulose nitrate, or celluloid, the first commercial plastic. Although this transparent, formable plastic had a relatively high ignition temperature, it also had a high burning rate; and although new materials have been made available since the celluloid days, public thinking often recalls celluloid fires. For this reason it must be emphasized that virtually all commercial plastics today either burn slowly compared with other common construction materials or fail to continue to burn upon removal of the ignition source.

In terms of heat resistance, thermoplastics as well as thermosets have distortion and softening temperatures well above the ranges necessary for fluorescent applications. Likewise the continuous heat

TABLE I — Properties of Plastics Used in Light Control.

PROPERTIES AND UNITS (a)		THERMOPLASTICS				THERMOSETS	
		Acrylic	Polystyrene		Vinyl (PVC)	Polyester	Urea Formaldehyde
		General Purpose & Heat Resistant	General Purpose & Heat Resistant	Light Stabilized	Rigid	Chopped Glass Strand Reinforced	Alpha Cellulose Filled
Physical	Specific Gravity	1.18	1.05	1.05	1.35-1.58	1.5-2.0	1.5
	Impact Strength, Ft.-Lbs./In. of Notch	0.4-0.5	0.25-0.5	0.5	0.4-2.0	7+	0.3
	Elongation, %	2-10	1.0-3.5	1.5-2.0	5-15	(g)	0.5-1.0
Permanence	Water Absorption, %	0.3	0.1	0.1	0.1-0.4	0.2	0.1-0.8
	Weatherability (b)	Good	Good	Poor-Fair	Fair-Good	Good	Good
Thermal	Continuous Heat Resistance, °F. (c)	140-200	150-205	150-160	130-160	180-350	170-250
	Burning Rate	Slow	Slow	Slow	S.E. (f)	Slow to S.E. (f)	S.E. (f)
Optical	Maximum Light Transmission, %	92	90	90	80-88	65	65
	Color Range	Unlimited				Translucents and Opaques Only	
	Fluorescent Light Life yrs. (d)	10+	2-3	5+	5+	5+	5+
Methods of Fabrication (e)	Calendering				✓		
	Compression Molding						✓
	Extrusion	✓	✓	✓	✓		
	Hot Forming	✓	✓	✓	✓		
	Injection Molding	✓	✓	✓			
	Low Pressure Laminating					✓	

(a) Averages have been listed where narrow ranges among materials of a given type are known to exist. The following American Society for Testing Materials (A.S.T.M.) methods of test apply to the properties listed: Specific Gravity, D792; Impact Strength, Izod, 73.4°F, D256; Elongation, D638; Water Absorption, D570; Burning Rate (Flamability), D635; Maximum Light Transmission (of Thermoplastics), D791 and D1003. Data sources are as follows: (1) Manufacturers' published data. (2) *Technical Data on Plastics*, October 1952, Manufacturing Chemists' Association, Inc., Washington 5, D. C. (3) The Dow Chemical Company, Midland, Mich.

(b) Weatherability ratings, obtained by exposing plastic samples outdoors, include changes in physical, chemical and optical properties.

(c) Continuous heat resistance or maximum recommended continuous service temperature depends to a large extent upon the size and shape of the part, the method and conditions of fabrication, the amount and distribution of applied stress, and extraneous exposure conditions.

(d) Fluorescent light life data indicate service life before objectionable yellowing to be expected from installations of plastic diffusers in fluorescent luminaires incorporating standard warm white lamps operating under normal conditions of energy input in normal commercial or industrial lighting systems. These data were obtained from (1) a knowledge of performance in existing installations or (2) comparison of accelerated aging (Fadeometer) stability of newer materials with similar data on materials of known characteristics. These data depend on the distance between the fluorescent light source and the plastic as well as the nature of impinging light. Thus, plastics in normal luminous ceiling applications (in which lamp-to-plastic distances are relatively large) would be expected to have longer life before objectionable yellowing than that indicated in the chart.

(e) Fabrication methods listed are those commonly used to produce light diffusing media. Some of the methods are applicable to the material in question primarily for other applications, and are therefore not indicated.

(f) S.E. — Self-extinguishing.

(g) Varies widely depending upon amount, type, and distribution of glass as well as nature of resin.

resistance of each of these materials is quite sufficient. However, special care should be taken in designing and choosing plastics for incandescent uses to avoid excessive heat build up. Thermosetting materials are almost always specified in these cases.

Optical Properties

Optical properties of interest include transmission, reflection, diffusion, and hiding power* as well as available color range and resistance to color change. Thermoplastics in lighting use are outstanding in total luminous transmission, the average being in the neighborhood of 90 per cent. This figure is based on the raw plastic in its unpigmented form. By proper compounding with a standard white pigment, very little of this high transmission is sacrificed in practical thicknesses. Transmissions of thermoplastics are also rather insensitive to changes in thickness; thus, thickness variations as large as 0.015 inch frequently result in only 3 to 5 per cent change in transmission.

Thermosetting plastics, on the other hand, have a maximum light transmission of about 65 per cent. Pigmentation of these materials to provide good diffusion would impose serious limitations on the transmission of a lighting unit. Hence, lighting usage of thermosets is confined almost exclusively to reflecting type fixtures, structural applications and glazing.

*In practice, hiding power and diffusion imply similar characteristics.

Dimensional Stability

Dimensional stability means resistance to changes in shape or dimensions due to volatile loss from the plastic, absorption of water, relief of internal stresses or any combination of these factors. Fortunately none of the current commercial plastics exhibits any serious lack of dimensional stability that is inherent or that cannot be accounted for by proper design and fabrication. Plastics manufacturers have found this true from experience in a wide variety of uses where dimensional stability is really critical. The reasons dimensional problems are not as bothersome as they might be can be traced back to "tailor-made" plastics, proper design, and careful fabrication.

Thermal Expansion

Coefficient of thermal expansion has been purposely chosen as the next property to consider because it is so often associated with dimensional stability even though the two should be treated separately — they actually refer to different effects. For this reason many designers who are thoroughly familiar with metals have been dismayed by the thermal behavior of plastics. The answer is simple — plastics expand 2 to 10 times as much as common metals with each degree of temperature rise. Therefore, assemblies which undergo wide temperature variations and which incorporate fastening devices should allow the plastic part to "float." The degree of "float" allowed may be calculated from the known coefficients of thermal expansion of the plastic and metal and the expected end use temperature variation. Of course the assembly temperature must be known and used as the base line in each case.

Chemical Resistance

It should be emphasized that no single commercial plastic resists chemical attack by all reagents under all exposure conditions. Rather, plastics have what is better termed "selective chemical resistance." Furthermore, plastics do not corrode or rust as do many metals when exposed to water, chemical solutions, or corrosive fumes.*

Special Plastics Problems Encountered in Fluorescent Lighting

As all of us know, specific problems usually arise when materials go into new applications, and many times the solutions to those problems come with difficulty from field experience, laboratory data, consumer opinion and the production plant. But once these problems are defined and understood and solutions to them begin to take shape, we can go ahead with confidence. This is just about where plastics stand in the lighting industry today.

Color Standardization

Many of today's lighting installations are suffering from non-uniformity of color — a direct result of failure to standardize colors. Consequently, replacement of one plastic diffuser or fluorescent tube in a multiunit installation quite often has very little chance of matching the remaining units in the color of transmitted light.

The situation is not as simple as it may seem when one considers that the "same" lamp supplied by several manufacturers may show more variation in color through the same plastic sample than several different "shades" of white plastic. Obviously, these color differences may frequently occur in service at lamp replacement time unless group replacement is practiced.

Nonetheless, standardization of 1, 2 or at most 3 diffusing white colors in each of the various plastics is desirable and should be encouraged. Unfortunately, there is little hope for satisfactory color matches between the various plastics because of inherent differences in optical properties; that is, differences in index of refraction, molar refractivity and dispersion.

But color standardization carries more implications than mere eye appeal. Plastics production

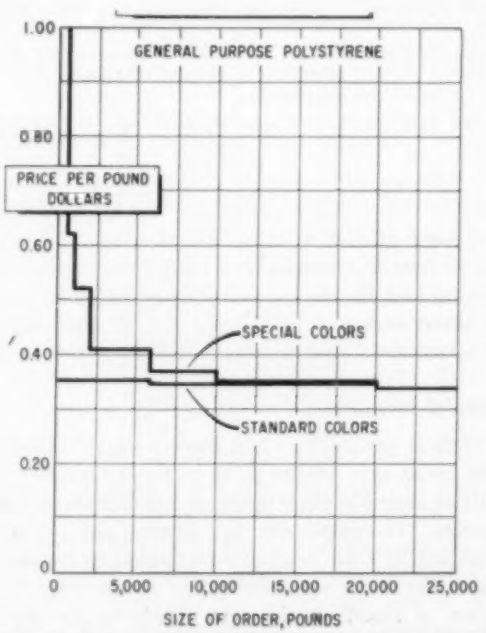


Figure 7. Color standardization reduces material costs.

*Some lighting applications have taken advantage of this valuable property. The British, for example, have successfully used rigid PVC for reflective luminaires in those areas where fumes corrosive to metals are encountered.

plants are designed for large volume continuous operation. Large numbers of colors result in small volume orders. These in turn make for short production runs requiring special handling.

Notice how this affects the price of general purpose polystyrene in standard and special colors (Fig. 7). None of these standard colors are specific to the fluorescent lighting field so the consumer must pay a special color price.

The same general price picture applies to other commercial plastics. However, standardization will change this picture and the change will be significant enough to lower lighting unit costs.

Hiding Power

Fig. 8 illustrates two degrees of hiding power in polystyrene at the same light transmission — in this case 55 per cent. Thus, hiding power has been obtained without sacrificing transmission.

In the same way two different transmissions can be obtained at the same degree of hiding power. Modifications of both sorts are brought about by varying the type and dispersion of incorporated pigments, and to a lesser extent by modifying the surface finish. For example, greater hiding power is obtained with a matte or rough finish rather than with a gloss finish. Degree of gloss is generally associated with the base plastic, but can be influenced greatly in the fabrication process. A normally glossy plastic can be surface roughened by using a rough surface mold, by embossing, by abrading the plastic, or more commonly, by adjusting mold temperatures in extrusion and injection molding.

Diffuser Life

Light stability or the resistance of plastics to color change under the action of fluorescent lamps has been the subject of much controversy. In some cases plastics yellowed in both light diffusers and back-lighted signs; in others acceptable service life was obtained before objectionable yellowing occurred.

There is no single reason for such inconsistency. Successes were in part due to proper selection of the plastic, design of the installation, and selection of the light source. There is little doubt that many successes were also the result of a fortunate but unplanned combination of these factors.

Failures, on the other hand, can now be traced to one or more of the following:

(1) Improper choice of the plastic.

(2) Poor design, such as a light source too close to the plastic diffuser.

(3) Poor fabrication or workmanship practices.

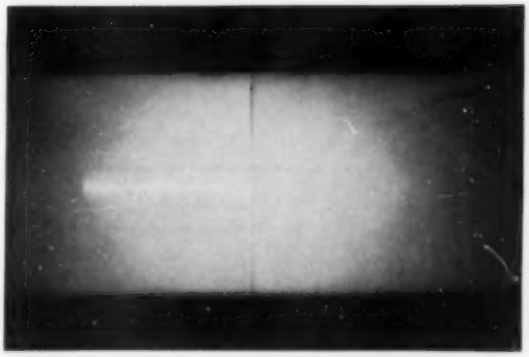


Figure 8. Hiding power is obtained in the panel at the right without loss of transmission (55 per cent in each case).

(4) Wrong choice of maintenance methods.

(5) Severe operating conditions; for example, excessive temperatures or outdoor exposure.

Ways of accounting for most of these factors are known well enough now to prevent serious failures. However, predictions of service life must be made possible in order to permit accurate comparisons between plastics.

Most studies show conclusively that the ultraviolet portion of any light source has the greatest effect on the physical and optical properties of plastics. Generally, high concentrations of ultraviolet (particularly low wave length UV) should be avoided. Although fluorescent lamps emit relatively small amounts of ultraviolet compared with visible light they can, under certain conditions,

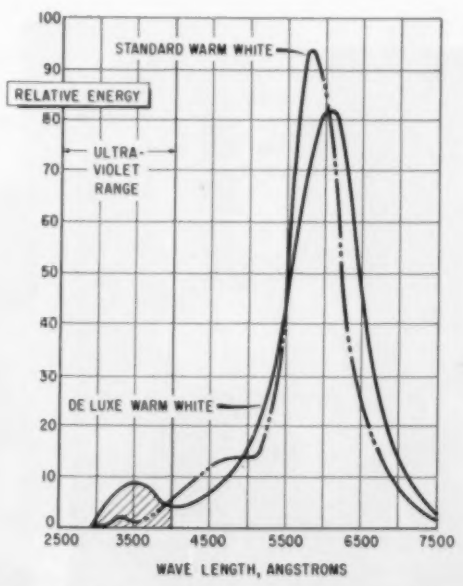


Figure 9. Spectral distribution of fluorescent lamps.

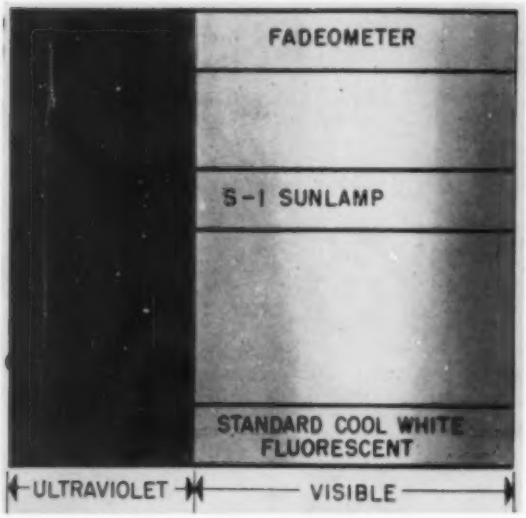


Figure 10. Radiation of light sources.

have bad effects on the plastic color. Furthermore, fluorescent lamps of higher ultraviolet, such as the deluxe warm white, are more degrading than standard whites. (Fig. 9) The result is a color change, usually toward yellow, which may become objectionable.

The question arises: just how can we tell in advance whether or not this color change will occur, and how long will it take under some set of use conditions to make itself visible?

It goes without saying that performance characteristics are best observed in actual use over a long period of time. Plastics have only a recent history in fluorescent lighting and, understandably, performance data are somewhat limited

If our basis for prediction is to be a laboratory test, then that test should accelerate the changes expected in service so that answers can be had in a reasonable time. But choosing this test is not simply a case of picking the one that accelerates the change the greatest, because to do so would require pure ultraviolet light. This is a far cry from duplicating fluorescent lamps. In other words, light sources that emit large amounts of ultraviolet, like the germicidal lamp and the S-1 sunlamp, do not give the answers needed for predicting useful life because they do not radiate the same kind of light as fluorescent tubes.

Fig. 10 shows that same reasoning in graphical form. The dark part represents ultraviolet or invisible light, and the remainder visible light.

The standard warm white fluorescent lamp covers the visible range and a little bit of ultraviolet. Compare this with the germicidal lamp and S-1 sunlamp. Not only do they go deep into the ultraviolet range but they also have energy peaks here. Nevertheless, these high ultraviolet sources draw wide-spread interest because of the tremendous acceleration possible in yellowing many plastics.

For the same and other reasons, outdoor tests are not pertinent to indoor fluorescent usage and should not be used to control production, to compare diffusing plastics, or to choose new materials for light control.

But this problem is not without a solution. The Atlas Fadeometer (Fig. 11) is used widely for this

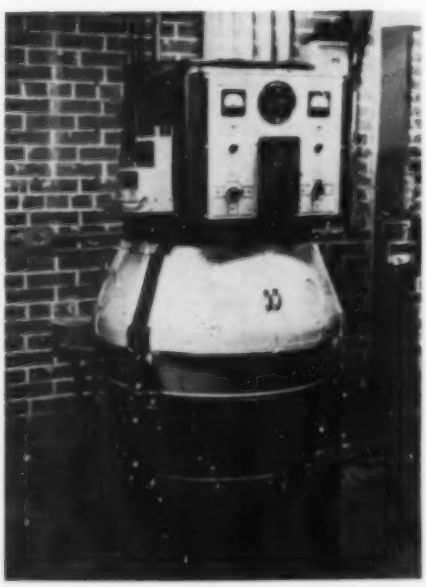
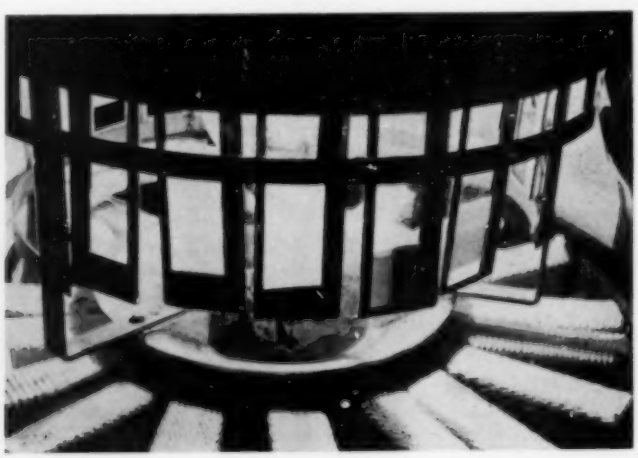


Figure 11. (left) Atlas Fade-Ometer® Carbon Arc Accelerated Aging Machine.

Figure 12. (below) Fadeometer sample rack rotates around the carbon arc.



type of testing because it emits light that corresponds with light from the most-used fluorescent tubes. For lighting purposes, it represents the best accelerating device yet available because it not only cover the same wavelength range as the fluorescent tube, but because it also has its energy peak at the visible-invisible dividing line or wavelength rather than in the ultraviolet range.

Basically it consists of a carbon arc around which plastic samples are rotated in the central part of the equipment. The light level is very high, roughly comparable to that of sunlight on a June day.

The operating part of the Fadeometer, where samples are mounted for testing at controlled temperature and humidity, is shown in Fig. 12. In actual operation, results are expressed as hours to reach a predetermined color or degree of color change or simply as the color after a given number of exposure hours. Both samples shown here have been exposed the same amount of time. Those on the right that have been badly discolored consist of unstabilized material. Those on the left have been properly stabilized and can be safely recommended for use in most fluorescent lighting applications.

Ultraviolet Light Stability

How do we put this Fadeometer data to work? Experience has proved that correlation between Fadeometer exposure and actual use must be established for a given material type. That is, the ratio of Fadeometer stability to service life varies with the type of plastic. But once a reasonable correlation is known, it becomes possible to make predictions of service life for new materials.

For example, general purpose polystyrene is good for 2 to 3 years (on the average) in fluorescent usage before objectionable yellowing occurs. About 150 Fadeometer hours are required to produce an equivalent change. By comparison, Q-4056,* a light stabilized formulation of Dow polystyrene, frequently goes in excess of 1,000 hours in the Fadeometer before the same degree of yellowing is reached. Granted, this average 7 to 1 ratio for light stabilized vs. general purpose polystyrene will vary up or down depending upon fixture design, especially the distance between fluorescent tube and plastic. However, these design factors can be accounted for fairly well.

Fig. 13 shows the type of fixture used to evaluate Q-4056 under conditions felt to be somewhat rougher than normal. The egg-crate sections are located $\frac{1}{8}$ inch below the fluorescent lamps; the D-shaped side sections $1\frac{3}{8}$ inches from the lamps. This fixture has been operating (as of May 15, 1956) continuously—24 hours a day for 22 months, using standard cool white 96-inch T12 slimline lamps. The general purpose polystyrene parts yellowed within a few months of service whereas the retained white color of the Q-4056 sections (the larger modules in the center of the fixture) cannot be distinguished from the color of unexposed parts.

Of course these tests will be continued in expectation of much longer freedom from yellowing and color change based on Fadeometer tests. At present approximately four to five years of normal usage have been obtained. Thus, light stabilized polystyrene offers marked improvement over general purpose material and can be expected to have a useful life in fluorescent applications of five or more years.

Use of a stabilizing system, however, is apparently not the only way to improve the light stability of polystyrene. The Plax Corporation reports that biaxial orientation or stretching immediately after sheet extrusion not only builds toughness but also improves light stability and weatherability. Polyflex, as it is known in the trade, was claimed to show no serious degradation after 18 months outdoors at Hartford, Connecticut; standard polystyrene deteriorates in a shorter time.[1]

Static Dust Collection

Another common problem characteristic of many plastics and especially those used in light control is static dust collection or dust pickup from the atmosphere.[2] The reason for this is that most plastics are inherently good electric insulators and many of them have very high surface resistivity.

Figure 13. Continuous exposure of Q-4056 light stabilized Dow polystyrene (larger modules in center of picture) for 22 months shows no indication of yellowing.

*Developmental successor to Styron 647.

Figure 14. Luminous ceiling of Polyflex® biaxially oriented polystyrene. (Photo courtesy Plax Corp.)

This leads to accumulation of static electric charge which attracts dust. The usual result is an unsightly appearance and reduced efficiency of the lighting unit.

Solution to this problem lies in the current selection and use of cleaners and destaticizers. Contrary to popular opinion, these maintenance operations are simple and cheap, since in most cases commercially available materials that do both a good cleaning and destaticizing job are recommended.

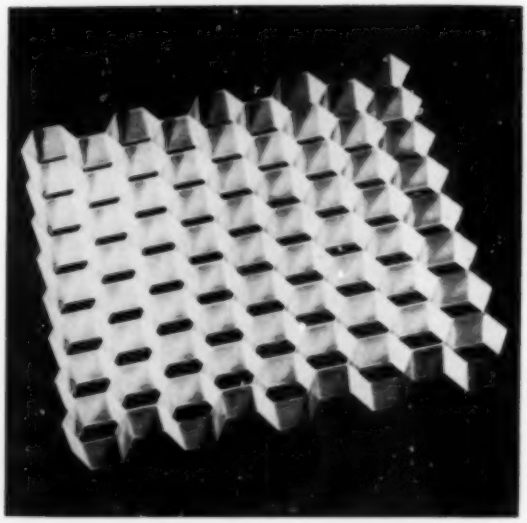


Figure 15. Polystyrene injection molded egg-crate diffuser for luminous ceiling and single fixture use.

Of course there are several requirements that have to be satisfied by a good cleaner and destaticizer. First, it should effectively reduce the static charge over the operating temperature range of the plastic part. Second, it should be resistant to dry rubbing. Third, it should have no detrimental effects on the strength, surface finish, or light stability of the plastic; and fourth, it should be easy to apply by wiping, dipping, or spraying.

One word of caution — since all of these requirements must be met, it is easy to see why a good destaticizer for one plastic may fail when applied to another. In cases of doubt, the plastic manufacturer should be contacted for appropriate laboratory tests.

Which plastics should be cleaned and destaticized? All thermoplastics, particularly transparents.

Figure 16. Corrugated vinyl ceiling. (Photo courtesy Luminous Ceilings, Inc.)

Building Code Requirements

Virtually all commercial plastics present no unusual fire hazards compared with other common construction materials. For this reason the position of the National Board of Fire Underwriters and the various building code commissions is of great interest. This is particularly true of full ceiling applications. Unfortunately, no two groups look on plastics in the same way and, hence, the subject of

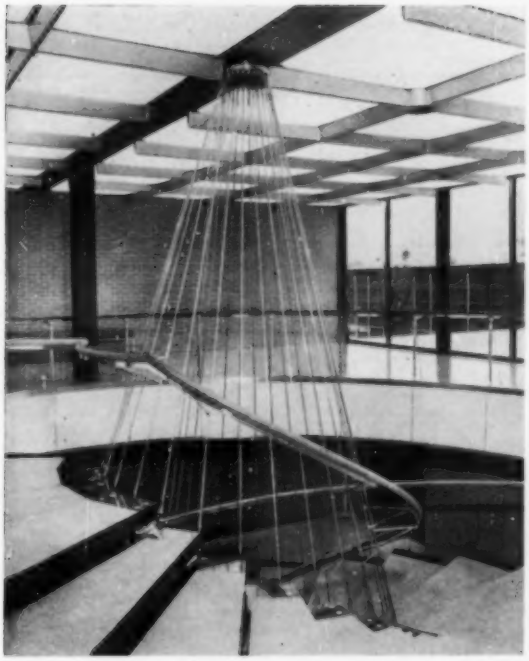


Figure 17. "Rigid-Arch" Plexiglas® luminous ceiling with acoustic treatment. (Photo courtesy General Motors Photographic Section.)

building code requirements becomes extremely complex. In the final analysis, few general statements can be made. What is emphasized here is that the fire hazard of plastics has been misrepresented in some cases and therefore needs to be treated in a more realistic manner.

Nonetheless, several types of plastic ceiling have been evaluated by the Underwriters, and several building codes allow their use in most areas and most occupancies. These include rigid PVC, oriented polystyrene and oriented methacrylate, both of the latter by Plax Corporation.[3] In general these materials are manufactured and installed so that they fall from their mountings at some temperature below that required to set off the sprinklers.

Some Interesting Applications

"Plastics in Lighting" would be far from complete without considering some of the more advanced, imaginative applications.

First to come to mind in today's architecturally engineered lighting is the plastic luminous ceiling. Vinyls, methacrylate, and polystyrene have led the way in this field by virtue of their high light transmission, low glare, easy fabrication, and simplicity of installation. Generally, two types of luminous ceiling are in use: the continuous form made from corrugated or flat sheet and the non-continuous or open type made up of molded and extruded parts. The distinction between these lies in the way light reaches the room. The continuous ceiling transmits all its light through the plastic; the non-continuous ceiling transmits some light through open spaces in the plastic parts, reflects light from plastic surfaces, and transmits a smaller amount through the plastic itself.

The shoe store pictured in Fig. 14 has its luminous ceiling in 0.015-inch thick Polyflex® biaxially oriented polystyrene panels. Hiding power has been achieved without sacrificing light transmission, permitting a closer spacing between lamp and plastic. As little as 2 inches is claimed sufficient for hiding lamps with this type of panel.

Polystyrene "egg-crate" injection moldings have long been used in a variety of luminous ceilings. Fig. 15 shows a typical egg-crate often used alone or in combination with other forms. Advantages include high lighting efficiency, good air circulation and light weight.

Corrugated vinyls likewise present interesting opportunities for architectural effects as in the children's store of Fig. 16. Soft, even lighting, ease of installation (the material is made in rolls) and acoustical baffles carrying service facilities are features of this ceiling.

"Rigid-Arch" Plexiglas® methacrylate diffusers make up the ceiling in Fig. 17. The modern trend and its dependence on both new materials such as plastics and older established materials like glass and brick stands out well in this view from the

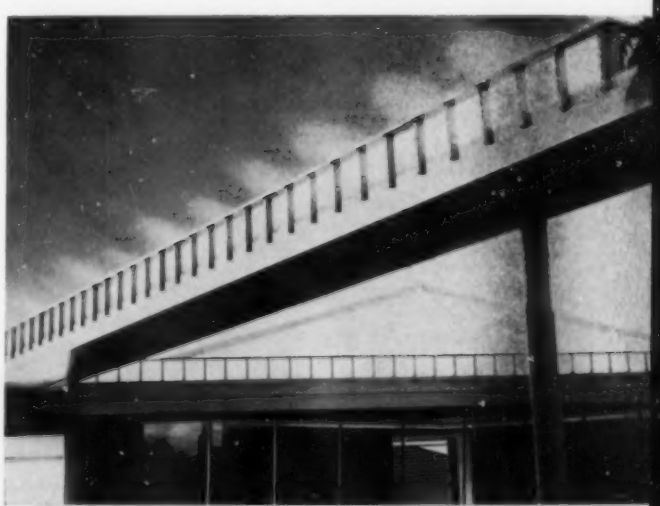


Figure 18. Cove lighting a church utilizing Dow light-stabilized Q-4056 polystyrene.

General Motors Research Building. Again, acoustical baffles take part in the structural detail.

For cove lighting and luminaire applications, the same basic materials are in use with polystyrene enjoying the greatest popularity. Fig. 18 shows Dow light stabilized Q-4056* in cove lighting a church. Extruded sheet is used.

Summary

Plastics have begun to fill some of the needs of a very large light control market. The most recent advances have been encouraging enough to stimulate wide-spread study.

The plastics industry, in attempting to supply light-engineered materials, must sustain its efforts in order to realize the full market potential. Responsibilities of plastics manufacturers, through inter-industry groups such as the Plastics for Lighting committee, are to develop and supply the necessary engineering data to ensure sound applications.

The lighting industry, likewise, has a major role; and that is to keep the plastics industry fully informed of all significant lighting developments. Cooperation will go a long way toward assuring top quality of plastics in lighting.

References

1. Fortner, C. Paul: "Biaxially Oriented Methacrylate and Polystyrene Sheet," *India Rubber World*, Vol. 129, No. 4, p. 493, January 1954.
2. Woodland, P. C. and Ziegler, E. E.: "Static Dust Collection on Plastics," *Modern Plastics*, Vol. 28, No. 9, pp. 95-106, 169, 171, 174-178.
3. Retardant 3448, December 20, 1951 and July 22, 1953 (Supplementary Report) "Acusti-Luminus Ceilings." Retardant 3641, September 25, 1953 "Sky Glo" and "Panel Glo" luminous type suspended ceilings. Retardant 3741, August 3, 1955 "Polyflex I" and "Methaflex" ceiling finish panels. Underwriters' Laboratories, Inc.

Bibliography

I — General
4. Commercial Standards CS168-50, CS173-50 and CS192-53, The Commodity Standards Division, Office of Industry Commerce, United States Department of Commerce, Washington, D. C.
5. "Stand-Ins That Made Good on Their Own," reprinted from *Business Week*, April 10, 1954.
6. Ziegler, E. E.: "Better Quality Through Product Evaluation," reprinted from *Hardware Retailer*, March 1954.
7. Dean, Russell T. and Manasia, Joseph P.: "Stabilization of Polyesters to Light," *Modern Plastics*, Vol. 32, No. 6, pp. 131-138, 233, February 1955.
8. Byers, J. S.: "Plastics Progress, 1953," Iliffe & Sons Ltd., London SE1, pp. 38-41.

II — Lighting Installations and Applications
9. "Lighting an Assembly Shop," *Architectural Forum*, Vol. 101, No. 5, p. 165, November 1954.
10. Moon, Parry and Spencer, Domina Eberle: "How to Design Your Luminous Ceilings," Illuminating Engineering, Vol. XLVI, pp. 295-298, June 1951.
11. Putnam, Russell C.: "Luminous Ceilings for Offices," Illuminating Engineering, Vol. XLVI, pp. 410-412, August 1951.
12. Oetting, R. L.: "Troffers and Luminous Ceilings Go Well Together," Illuminating Engineering, Vol. XLVI, pp. 543-545, November 1951.
13. Wakefield, T. D.: "Light and Sound Absorption," Illuminating Engineering, Vol. XLVI, pp. 567-568, November 1951.
14. Linforth, E. M.: "A Study of Large Area Acrylic Plastic Ceilings," Illuminating Engineering, Vol. XLVII, pp. 175-178, April 1952.
15. Putnam, Russell C., Waite, Rollin W., Siegel, L. C., and Bryan, W. L.: "Air Diffusion and Light Depreciation Tests of Luminous Ceilings," Illuminating Engineering, Vol. XLVII, pp. 274-277, May 1952.
16. Spencer, Domina Eberle and Martin, Leonard F.: "Time Versus Luminous Ceilings," Illuminating Engineering, Vol. XLVIII, pp. 268-276, May 1953.
17. Benson, Benjamin S., Jr. and Church, Eric H.: "Performance Versus Installation — Luminous Panel Systems," Illuminating Engineering, Vol. XLVIII, pp. 363-366, July 1953.
18. Greene, Bernard F.: "Daylighting with Plastic Domes," Illuminating Engineering, Vol. XLIX, pp. 209-215, April 1954.
19. "Luminous Ceiling in a Traditional Kitchen-Dinette," Illuminating Engineering, Vol. L, pp. 553-554, November 1955.
20. "Luminous Ceilings of New Vinyl Plastic," *Lighting*, Vol. 66, No. 3, pp. 24, 39, November 1954.
21. Riddle, W. D.: "A Look at Luminous Ceilings," *The Magazine of Light*, Vol. 22, No. 3, pp. 6-13, June 1953.
22. "Modern Architecture Breaks Through the Glass Barrier," *Architectural Forum*, Vol. 101, No. 6, pp. 104-111, December 1954.
23. Cooper, Berlon C.: "Electric Ceilings for Engineered Environment," reprinted from *Electrical Construction and Maintenance*, August 1954.
24. Yarm, Sidney D. and Hinds, George L.: "Lighting System Redesigned in Reinforced Plastics," *Modern Plastics*, Vol. 31, No. 11, pp. 104, 106, 108-109, July 1954.
25. "Plastics Push into Blue Chip Markets," *Modern Plastics*, Vol. 33, No. 5, pp. 103, January 1956.

III — Properties and Fabrication
26. *Modern Plastics Encyclopedia* issue, September 1955 (published yearly), Plastics Catalogue Corp., Bristol, Conn.
27. *Plastics Engineering Handbook* of The Society of the Plastics Industry, 2nd edition, Reinhold Publishing Corp., New York, N. Y., 1954.
28. *Technical Data on Plastics*, October 1952, Manufacturing Chemists' Association, Inc., Washington 5, D. C.
29. "Materials for Light Control," Illuminating Engineering, Vol. L, pp. 98-99, February 1955 .

IV — Street Lighting Applications
30. "More Light on Highways," *Modern Plastics*, Vol. 30, No. 10, pp. 95-97, June 1953.

V — Structural Uses
31. Dietz, Albert G. H.: "Better Buildings with Plastics," *Modern Plastics*, Vol. 32, No. 6, pp. 85-90, 216, February 1955.

*Developmental successor to Styron 647.

I.E.S. Emblem

The official emblem of the Illuminating Engineering Society is available to members in 14-karat gold, lapel screw back buttons, in the miniature ½-inch size, at only $3.50 each including taxes. Background of emblem is blue for Members, red for Associate Members. Emblems may be ordered from the General Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Measuring Electrical Output of Rapid Start Ballasts by a Light Output Method

By R. D. BRADLEY
M. M. BUZAN

THE MEASUREMENT of output watts to the lamp in rapid-start circuits is so difficult, that in most instances it becomes impractical to attempt it by normal laboratory means. With other types of ballasts, such as slimline or switch-start, it has been possible to determine the electrical characteristics by inserting voltmeters, ammeters, and wattmeters in both the primary and secondary circuits of the ballast. Watts loss in the ballast was determined as the difference between the output watts and the input watts. Power factor was calculated as the input watts divided by the input volt-amperes.

In the circuitry for rapid-start lamps a second appreciable wattage, in the form of cathode heater wattage (usually not in phase with arc watts), is mixed with the arc wattage. It is the inability of common laboratory instruments to separate the two quantities which leads us to our problem, the measurement of lamp (or arc) watts in rapid-start circuits.

Instrumentation

In analyzing the problem and discussing it with ballast people, it was decided to try a new approach, comparative light readings. Now, in addition to a voltmeter, wattmeter and ammeter, some form of photometer and a calibrated light source must be available. For the photometer, we used a Leeds and Northrup Speedomax Recorder with matched color corrected cells. The calibrated light source was furnished by General Electric Company in the form of a ballast and two pairs of lamps.

The ballast, a catalog number 89G323 (2-lamp series sequence) had been used to burn one pair at a time of the two pairs of lamps. For input voltage settings of 106, 118 and 130 volts to the ballast, the respective readings of input current and input wattage were read and recorded. Readings of light output were noted and recorded. The ballast was then disconnected and standard reactors placed in each lamp circuit. These reactors were then adjusted to give the same light output as noted previously and volts, amps and watts of the lamp were recorded. The wattage delivered by the reactors was then accepted as being the same as the ballast lamp wattage which gave the same light output. The same procedure was used on the second pair of lamps so that there were two sets of standards from which to work. The wattage for each lamp was recorded as well as its position in the ballast circuit.

AUTHORS: Day-Brite Lighting, Inc., St. Louis, Missouri.

Procedure

In order to use these standards, they had to be inserted into our photometer and recalibrated into values which could be readily duplicated.

One of the first things that this type of measuring demands is a constant ambient temperature free of drafts. Using a thermostatic control of our air conditioning unit mounted at the photometer, the temperature was held at 80 degrees Fahrenheit plus or minus one degree. To limit the drafts, large baffles were placed around the photometer area.

A pair of the lamps was mounted one on either side of a black bar and placed on the photometer. So that the lamps could always be placed in the same relative position, indexing marks were filed on the bases. The lamp sockets were then attached to the same leads of the ballast that they had been when originally calibrated. The primary of the ballast was fed from a Solavolt constant voltage transformer having corrected wave form, as it was found that line fluctuations and poor regulation of wave form introduced wide variations in the results.

Into the primary of the circuit was inserted a voltmeter, ammeter and wattmeter. With these, the input quantities were measured.

Twenty feet away from the lamps a pair of matched, color corrected cells was used to pick up the light and feed it to a Leeds and Northrup Speedomax recorder. The recorder was standardized using the internal standard cell.

When the ballast had been energized long enough to become stable (about two hours), the input voltage was set at 106 volts and the current and wattage recorded. A reading of the light output from the two lamps was recorded on the Speedomax recorder. The same readings were then recorded for input voltages of 118 and 130.

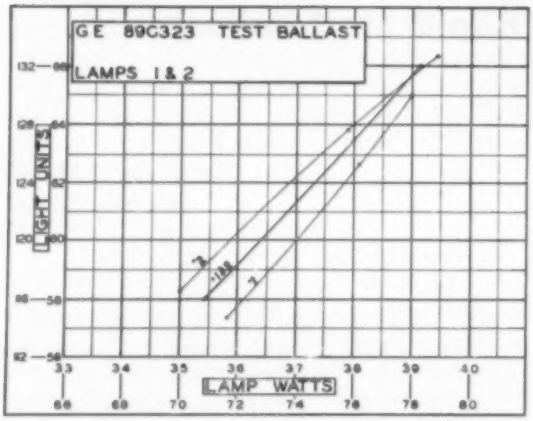


Figure 1. Wattage versus light output for lamp #2; lamps #1 & #2, and lamp #1.

Next a baffle was placed in front of first one lamp and then the other, and the light output recorded for each lamp individually as the voltage was changed.

Using these values of light output and the wattage as determined by the standard reactors for these lamps, it was now possible to plot curves of light output *vs* wattage for each lamp and the combination. This meant that the lamps had been recalibrated to the instrumentation at hand. If the cell distance were to be changed or a different recorder or cells used then new curves would be required.

The same sort of procedure was followed for the second set of lamps and a set of curves plotted.

Now that the preliminary work of adjusting and standardizing the equipment had been accomplished the measuring of the lamp watts for an unknown ballast was relatively easy. The unknown ballast was wired to one of the pairs of lamps and energized until the system became stable. With the input voltage set at its rated voltage (118 volts), the input current, input wattage and light output were recorded. Using the light output curves for the lamps being used, lamp wattage was determined. This value did not have the cathode heater wattage included. Cathode heater watts was included as part of ballast watts loss which was the difference between input watts and the ballast output watts.

Primary power factor was determined by using the recorded values of volts, watts and current.

Precautions

After taking twelve sets of data, the following precautionary steps were found necessary in order to be able to duplicate results within approximately one per cent.

1. Test lamps must always be installed in the same place in the electrical circuit and indexed so that the same part of the lamp is exposed to the test cell.
2. Room temperature must be held within plus or minus one degree Fahrenheit without drafts.
3. Lamps must be burned horizontally.
4. In shielding one lamp in a two-lamp set-up, the shield must be so arranged as to allow normal air circulation around the shielded lamp.
5. Ballasts must be stabilized at maximum temperature. (Will take two-three hours.)
6. If constant potential transformer is used it must be wave form corrected.
7. Make instrument loss corrections in accordance with hookup used.

It will be noted that lamps have definite individualities when comparing wattage against light output. This is readily noted from the curves shown in Fig. 1.

Lamps and ballasts could have been standardized in our photometric laboratory if standard reactors had been available. This procedure would eliminate the recalibration on a different photometer.

February 1 Is Deadline For 1957 Conference Paper Outlines

The I.E.S. Papers Committee has set a deadline of February 1 for outlines of proposed papers for the 1957 National Technical Conference.

Outlines of proposed papers, in triplicate, should be mailed to:

H. F. Davidson
Chairman, I.E.S. Papers Committee
c/o Hydro-Electric Power Commission of Ontario
620 University Avenue
Toronto 2, Ontario, Canada

New Developments In Short Arc Lamps

By THEODORE C. RETZER
GEORGE W. GERUNG

Development progress on high pressure short arc lamps is covered in sizes from 800 watts to 2500 watts. Improvements in design features which have made these lamps practical for various applications are described. Electrical characteristics, arc brightness, spectral energy distribution curves and applications of the different lamps are presented.

THERE HAS always been a need for a brilliant, long-life, bulb-type light source for use in high powered searchlights and projection equipment. The high brightness and the long life of mercury lamps have led to extensive efforts to develop a projection lamp of this type. High pressure mercury lamps with short arc lengths, called short arc lamps, are the result of this work. Short arc type lamps have been made experimentally in the United States since World War II, and prior to that in Germany, England and Japan.[1] Research and development in the United States during recent years have resulted in commercially available mercury and mercury-xenon short arc lamps. Improvements in high-current quartz seals, and a newly designed electrode, permitting longer useful lamp life on alternating current than heretofore obtainable, have made these lamps practical for commercial applications. Five short arc lamps, their design features, operating characteristics, and applications, are described herein.

The short arc lamps are shown in Fig. 1. The lamps are made with clear fused quartz bulbs which are spherical in shape and have two diametrically opposite current carrying seal arms. The lamps have flexible electrical connectors and are equipped with cushioned stainless steel mounting collars clamped directly to the clear quartz portion of the seal arms. This type of mounting is compact, rugged and suitable for most applications. The mercury-xenon lamps are filled to two or more atmospheres of xenon gas, and in order to eliminate a possible hazard during shipment, storage, or handling of the cold lamps, special protective cases are provided,[2] as shown in Fig. 2. These cases are made of metal and are so arranged around the bulb that the lamp can be electrically connected and adjusted in the fixture without removing the case. The case should not be opened and removed until immediately before the lamp is put into operation.

All short arc lamps develop considerable internal pressure during operation (see Table I) and therefore must be operated in an enclosure at all times. Further, precautions must be taken for protection from the powerful ultraviolet radiations emitted by the lamps.

In selecting the bulb sizes for the various wattages, consideration was given to speed of warm-up and to lamp life. The bulbs were designed with a wattage loading which will give several hundred hours of lamp life without devitrification of the quartz when the lamp is operated in the recommended position.

The lamps are designed to operate with natural air-draft cooling. No special ventilation is required unless the lamps are operated in a closely confining fixture or at excessive ambient temperature.

The essential technical data for the various lamps are given in Table I. The lamps are designed for alternating current operation, and the values apply to their use on alternating current circuits. However, limited testing on direct current has given good results with the lamp operated in the vertical position and the positive electrical connection made to the lower electrode.

Lamp Design and Construction

Electrode Design Criteria

Most of the published work in Europe and England has been devoted to direct current type lamps.[3,4] It is well known that direct current operation of high pressure discharge lamps permits better light maintenance throughout lamp life than does alternating current operation. However, the more extensive use of alternating current in the United States makes alternating current types preferred in this country. In general, electrode design for direct current high pressure discharge lamps is easier than for alternating current lamps, in regard

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 17-21, 1956, Boston, Mass. AUTHORS: Westinghouse Electric Corp., Bloomfield, N. J.

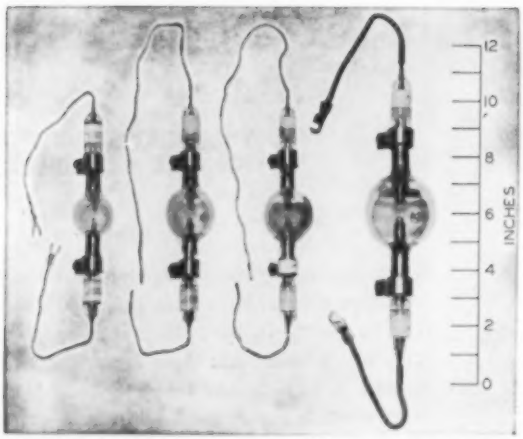


Figure 1. (Above) Five types of short arc lamps for a-c operation. From left to right: 800-watt mercury, 1000-watt mercury, 1000-watt mercury-xenon, 2500-watt mercury or mercury-xenon.

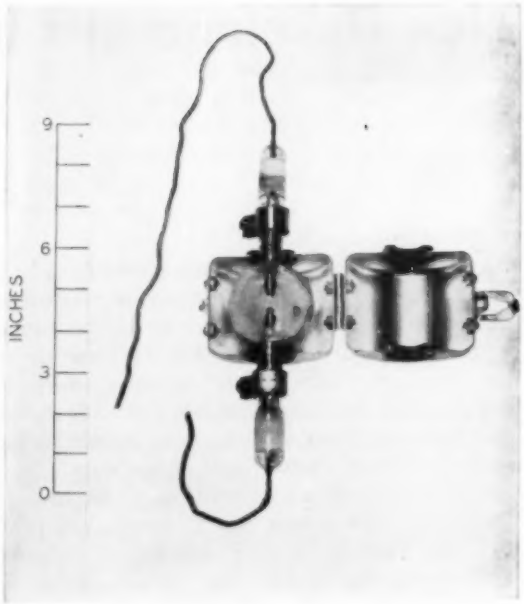


Figure 2. (Right) 1000-watt short arc mercury-xenon lamp with typical protective handling case.

to long useful life and arc stability. For one well skilled in the art, electrodes for direct current operation present no great problems, since each electrode is required to serve only one function. One electrode is designed to operate as a cathode and the other as an anode. To obtain the proper operating temperature the cathode is made smaller than the anode.

The design of electrodes for alternating current high pressure discharge lamps is more complex, since each electrode has to function both as a cathode and an anode. On 60-cycle alternating current this change takes place 60 times a second. The unique electrode design shown in Fig. 3 has proved to be highly satisfactory for alternating current operated lamps. The electrode consists of a continuous-wound triple-layer tungsten coil mounted on a tungsten rod which is also used for the lead-in conductor. The coil provides an excellent radiator of heat from the electrode tip because of the large radiating surfaces of the coil turns. This permits an electrode of smaller volume for a given size lamp than is possible with the commonly used type of short arc electrodes machined from a

TABLE I — Approximate Operating Characteristics of Five Types of Mercury and Mercury-Xenon Short Arc Lamps for a-c Operation.

Lamp Type*	SAH 800-C	SAH 1000-A	SAH 2500-A	SAHX 1000-A	Experimental SAHX 2500-A
Watts — Lamp Only (Approx.)	800	1000	2500	1000	2500
Arc Length, mm.	8.5	6.5	10	6.5	10
Brightness, c/sq.mm. (Max.)	180	400	300	400	300
Rated Avg. Life — Vertical Operation at 2 Hours per Start	300	300	200	300	100
Burning Position	Any	Vertical	Any	Vertical	Vertical
	G13	G16	G22	G16 (With PT Coating)	G22
Overall Length (Max.) Excluding Flex. Leads	9⅛"	9⅛"	13"	9¼"	13"
Starting Requirements	HV	HV	HV	HV	HV
(Fig. 11-A)	Pulse	Pulse	Pulse	Pulse	Pulse
(Fig. 11-B)	Spark Coil	Spark Coil	Spark Coil		
Operating Volts (Approx.)	70	65	65	65	65
Current (a-c Amps. Approx.) Starting	15	35	75	32	65
Operating	11.8	18	45	18	45
Operating Vapor Pressure (Atm. Approx.)	10	25	15	30	20
Rated Initial Lumens (at Zero Hours)	40,000	50,000	125,000	50,000	125,000
Time to Full Output Min. (Approx.)	6.5	6.5	6.5	2.5	2.5

*SAH designates short arc mercury.
SAHX designates short arc mercury xenon.

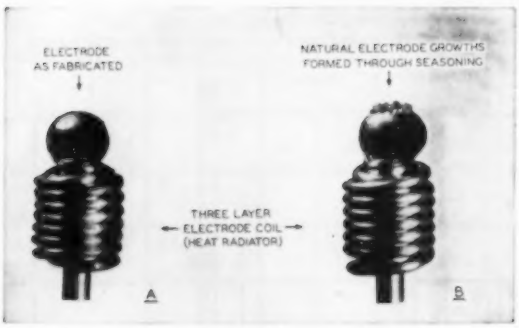


Figure 3. New design short arc electrode —
A — Electrode as fabricated.
B — Electrode showing natural growths formed during first two hours of operation.

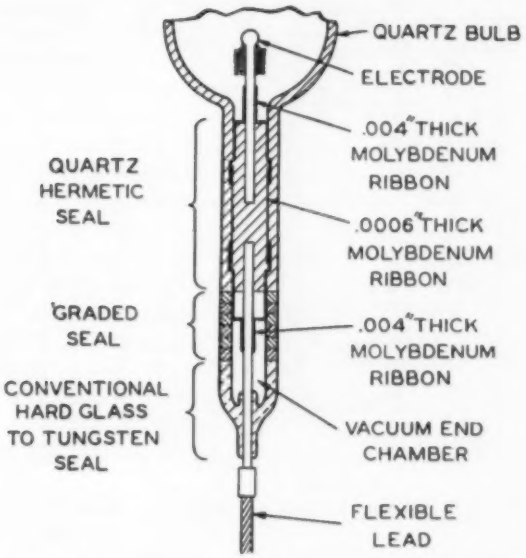


Figure 4. Cross-section view of new double hermetic seal.

solid piece of tungsten. The tip of the electrode is formed in the shape of a rounded ball by melting the coil to the tungsten rod. This is clearly shown in Fig. 3 (A). To facilitate lamp starting a small piece of thorium metal is embedded between the rod and the coil. For a given size lamp, electrodes are designed to operate at the proper temperature to give long useful lamp life. The size of the ball at the electrode tip is such that it operates near the melting piont of tungsten. At this high temperature the electrode tip provides a copious supply of electrons which practically eliminates sputtering of the electrode material during lamp operation. Tungsten evaporation during a life of several hundred hours is practically nil with the correct size ball at the electrode tip and the proper size radiator coil to regulate the rate of cooling from the electrode tip. These design features have been empirically determined, and can be controlled within practical manufacturing tolerances.

During the lamp starting period the discharge generally initiates from the coil turns which heat up quickly, preventing sputtering of tungsten from the electrode. The arc will continue to strike on the coil until the electrode tip is sufficiently hot to permit good emission, at which time the arc will emanate from the electrode tip. Thus the coil serves an important function during the starting cycle as well as regulating the electrode temperature during operation. At times the arc may initiate directly from the electrode tips and become hot within one or two seconds, thus providing good electron emission and preventing sputtering of electrode material.

An interesting phenomenon occurs at the electrode tip on alternating current operation. During the first two hours of lamp operation growths or pips form at the electrode tip as shown in Fig 3 (B). These pips may vary slightly in size and number, as the lamp continues to burn, but they

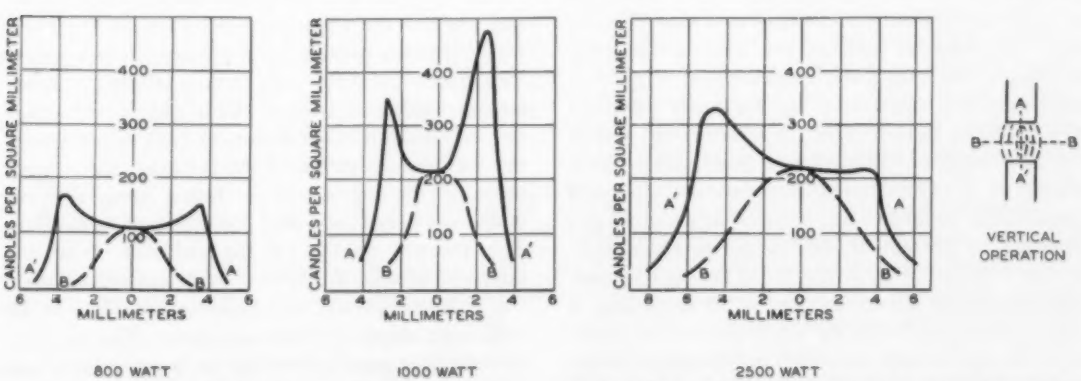
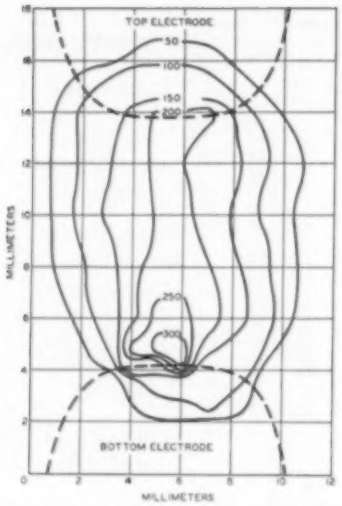


Figure 5. Typical brightness distribution across the arcs of the 800-, 1000- and 2500-watt short arc lamps.



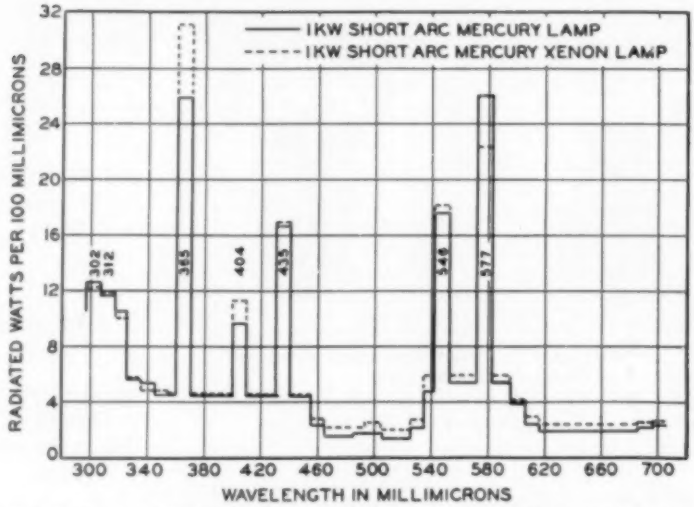


Figure 6. (Left) Typical arc brightness distribution of 2500-watt short arc lamp. Contour lines in candles per square millimeter.

Figure 7. (Right) Typical spectral energy distribution of the 1000-watt short arc mercury and mercury-xenon lamps between 300 and 700 millimicrons.

remain constant enough after the first two hours of seasoning to hold the arc voltage within a few volts throughout life. The pips improve the stability of the discharge by preventing wandering of the arc over the electrode surface.

Seal Design

The low coefficient of thermal expansion of quartz has presented difficult problems in developing a satisfactory hermetic seal of quartz and a current-carrying metallic conductor capable of handling heavy currents. Attempts to terminate in air thin molybdenum ribbons sealed in quartz frequently result in seal failures because above 200° C the molybdenum tends to oxidize in air. The development of the double seal shown in Fig. 4 eliminates this shortcoming.[5] Molybdenum ribbon .0006" thick sealed in quartz, as shown in Fig. 4, provides the hermetic seal to contain the ionizable gas and mercury within the lamp envelope. Heavier .004" molybdenum ribbons are used to facilitate welding to the thin .0006" ribbons and to provide good electrical connections to the lamp electrode and tungsten lead-in wire. A graded seal covers the coefficient of thermal expansion range from quartz to a conventional tungsten sealing hard glass. This arrangement permits a vacuum end chamber to prevent the oxidation of the molybdenum ribbons terminating from the quartz seal. Experience has shown that lamps of more than a few hundred watts can be made shorter in length with the double seal than with molybdenum ribbon seals terminated in air.

Operating Characteristics

The typical vertical and horizontal brightness scans of the 800-, 1000- and 2500-watt lamps shown in Fig. 5 apply equally to mercury and mercury-xenon lamps. Each lamp has a peak brightness at the lower electrode because the lower electrode operates cooler and has a tendency to build up a "hot spot" or emitting surface by concentrating the flow of electrons to an area smaller than the surface of the electrode. The upper electrode operates hotter because it is heated by convection, and the entire electrode surface tends to emit electrons. This reduces the concentration of electron flow and thus reduces brightness. The iso-brightness diagram (Fig. 6) of the 2500-watt short arc mercury lamp clearly shows the brightness "hot spot" at the lower electrode.

Fig. 7 shows the typical spectrum of the visible and part of the ultraviolet radiation of the 1000-watt short arc mercury and mercury-xenon lamps. The mercury-xenon lamp has a slightly higher energy continuum because of the addition of xenon gas. Although it is not shown, or fully investigated, the infrared spectrum of the mercury-xenon lamp contains the characteristic xenon spectral lines which are sometimes used for infrared projection. The spectral quality of the radiation from the lamps of various wattages is practically the same.

Fig. 8 shows the effect of adding xenon gas to the 1000-watt short arc mercury lamp. The addition of the xenon gas shortens the warm-up period from six minutes to three minutes. An additional 30 per

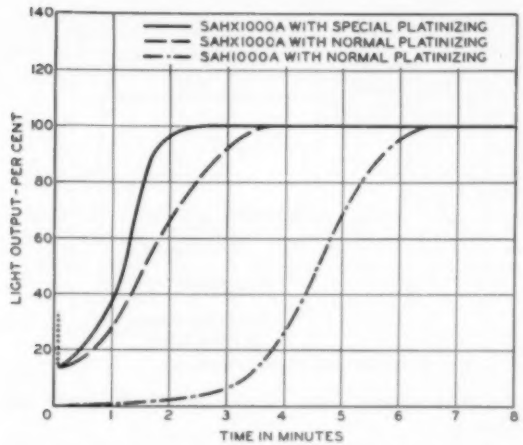

SAHX1000A WITH SPECIAL PLATINIZING
SAHX1000A WITH NORMAL PLATINIZING
SAH1000A WITH NORMAL PLATINIZING
LIGHT OUTPUT - PER CENT
TIME IN MINUTES

Figure 8. Typical warm-up curves for 1000-watt short arc lamps.

Dot-Dash line: SAH 1000-A mercury lamp with normal platinizing of outer bulb surface.

Dotted line: SAHX 1000-A mercury-xenon lamp with normal platinizing of outer bulb surface.

Solid line: SAHX 1000-A mercury-xenon lamp with special platinizing of outer bulb surface.

cent improvement in warm-up is gained through the two-thirds platinizing of one side of the lamp, shown in Fig. 9. Essentially this platinizing of the 1000-watt mercury-xenon lamp makes it a one-direction lamp. That is, the lamp is designed primarily for searchlights and projector systems which do not use an auxiliary mirror. Experience has shown that auxiliary mirrors used with a short arc lamp may be more detrimental than helpful because the lamp operates near the maximum loading of the bulb, and the redirecting of rays through the bulb may cause early blackening or violent failure. However, it is probable that the proper application of an auxiliary mirror with forced air cooling of the lamp would result in satisfactory operation.

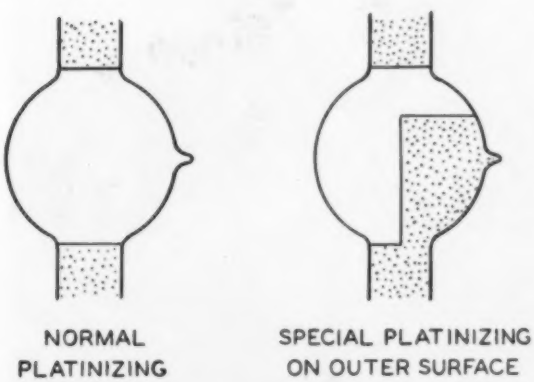


Figure 9. 1000-watt mercury lamp with normal platinizing and 1000-watt mercury-xenon lamp with special platinizing.

The maintenance curve for the 1000-watt short arc mercury-xenon lamp (Fig. 10) shows that this lamp drops only approximately 25 per cent in light output after 300 hours of operation. This feature of improved maintenance has made the relatively expensive short arc type lamp economically practical for searchlight and projection applications. With the price of the lamp remaining the same, the increase in useful lamp life from 100 hours to 300 hours effectively reduces lamp cost by two-thirds.

The average life ratings and maintenance ratings of the short arc lamps apply when they are operated in the vertical position. The 800- and 2500-watt mercury lamps may be burned in any position but best overall performance will be obtained with vertical operation. For mercury-xenon lamps and the 1000-watt mercury lamp the normal burning position is vertical. These lamps can be operated momentarily in any position, but prolonged operation at an angle exceeding 10 degrees from the vertical will seriously shorten lamp life. This restriction in burning position is necessary because the "tail flame" of the arc would overheat and destroy the upper side of the bulb if the lamp were operated horizontally for long periods. Furthermore the arc of the mercury-xenon lamp has a tendency to be unstable in horizontal operation.

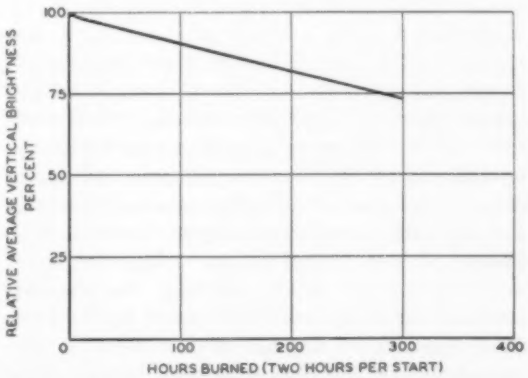


Figure 10. Average maintenance of arc brightness, 1000-watt mercury-xenon lamp.

Like most vapor discharge lamps, short arc lamps require auxiliary devices to start the arc and limit the current. Ballasts to limit the current during starting and operating may be either reactive or resistive. A high-voltage pulse starting circuit (Fig. 11-A) is required to start mercury-xenon

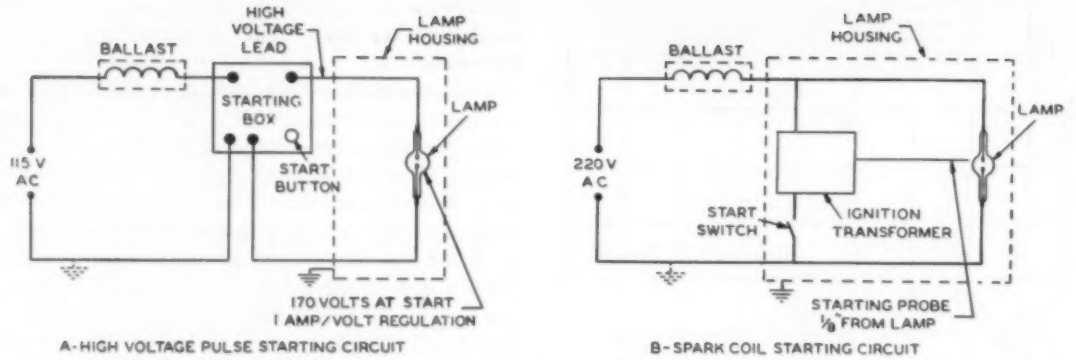


Figure 11. Typical operating circuit for short arc lamps: A. High voltage pulse starting circuit. B. Spark coil starting circuit.

lamps. This circuit consists of a pulse of approximately 50,000 volts generated by high frequency discharges through a spark gap, causing a discharge between the electrodes of the lamp which ionizes the gas and heats the electrodes to thermionic emitting temperature. Such a device will start either mercury or mercury-xenon lamps, hot or cold, and will restart them instantly. It is essential that the starting circuit be insulated properly and be located close to the lamp so that there is no leakage of high voltage or loss of high frequency power to prevent proper starting. An adequate starting circuit has sufficient power in the pulse discharges to start the lamp in three seconds. Prolonged high-voltage discharges prior to the normal starting of the arc will prematurely darken the lamp.

In mercury lamp installations where economic considerations are of the utmost importance a starting circuit incorporating a Tesla spark coil or an ignition transformer may be used (Fig. 11-B). However, it is necessary to allow the lamp to cool for a few minutes before it can be restarted. The momentary voltage at the pointed metal probe located near the bulb ionizes the starting gas in the lamp and causes the arc to strike across the electrode.

Application

Short arc lamps answer the need of the optical and searchlight designer for a brilliant, long life, "point light source" that can be operated by remote control over extended periods. To date, the principal application of short arc lamps can be divided into those which require a mercury-xenon lamp for quick warm-up and some initial light output and those which can tolerate the longer six- to eight-minute warm-up period of the straight mercury lamps. The individual installation and its economic factors determine this choice.

In an individual installation such as the 12-inch Navy Signalling searchlight (Fig. 12) a quick warm-up is essential, and the use of the mercury-xenon lamp is dictated. Because of the xenon gas and the platinum coating, the cost of the mercury-xenon lamp is greater than that of the straight

Figure 12. 12-inch Navy signalling searchlight with 1000-watt short arc mercury-xenon lamp.

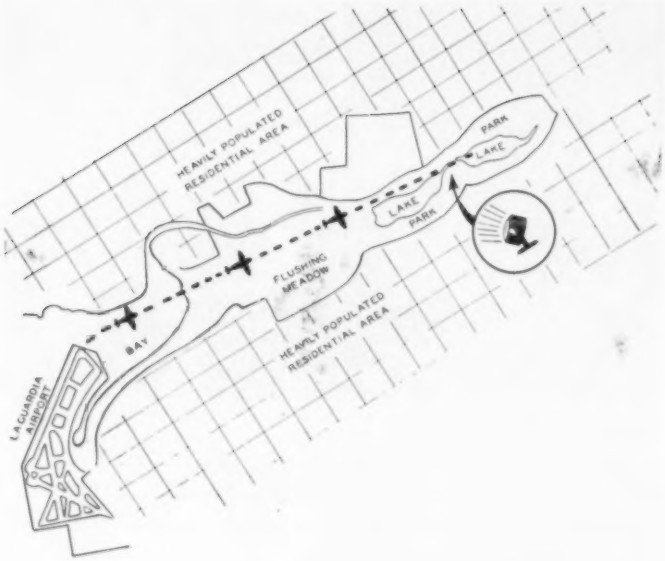


Figure 13. Air Lane immediately after plane take-off from runway 13 at La-Guardia Airport showing location of mercury searchlight.

mercury lamp. This differential in lamp cost must be weighed against the need for quick warm-up and initial light output. In addition to the difference in lamp cost the mercury-xenon lamp necessitates the use of a high voltage starting circuit, which in some cases can be eliminated with straight mercury lamps.

The 2500-watt short arc mercury lamp with its extended warm-up period is being used to replace the 11,000-watt 150-ampere carbon arc in converted 60-inch anti-aircraft searchlights. One of these converted units is used by the Civil Aeronautics Administration to solve a noise problem over the densely populated area around LaGuardia Airport. Planes taking off from runway No. 13 must make a turn immediately after take-off and be properly directed over Flushing Meadow Park to avoid flying at low altitude over a heavily populated residential area (Fig. 13). The turn could be made easily during daylight hours, but in the evening it was practically impossible because directional ground beacons could not be distinguished from surrounding street and ground lighting. The 2500-watt short arc mercury lamp in the 60-inch searchlight (Fig. 14) produces a column of light or a sky highway traffic light which is controlled from the

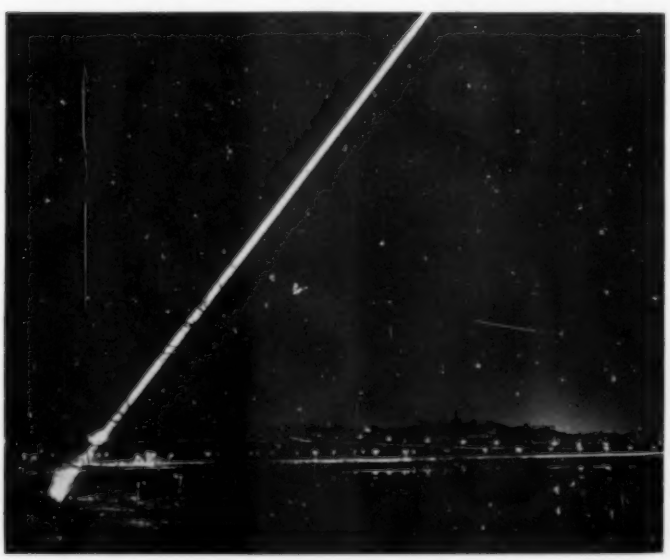


Figure 14. Sky Highway 60-inch searchlight using 2500-watt short arc mercury lamp.

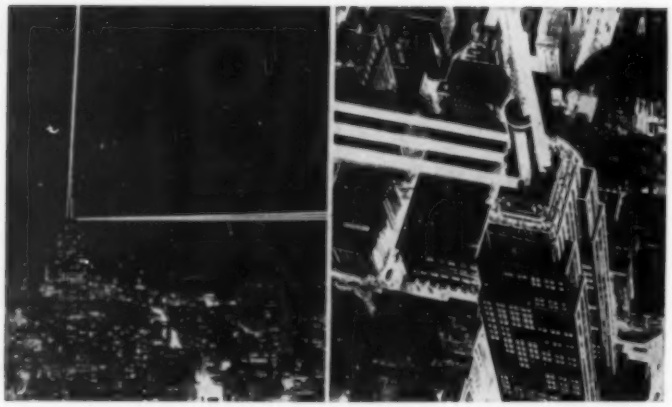


Figure 15. Two views of Empire State Building showing four revolving 60-inch searchlights each using a 2500-watt short arc mercury lamp.

airport traffic tower four miles away. It is seen by the pilot during night take-offs and guides him through the beam and away from heavily populated areas.

A similar type of installation is the ballet of light produced by the four searchlights on top of the Empire State Building (Fig. 15). This installation is the ultimate in remote control in searchlights and could only be made economically possible through the long life and practically maintenance-free 2500-watt lamp.

Aside from searchlight installations the short arc lamps are finding their place in photochemical applications in which ultraviolet radiation from a point source is required. The first of these installations was in the production of photo-sensitive glass. The middle ultraviolet radiation from the 800-watt lamp, directed in a parallel beam, has been found to be the most satisfactory source for sensitizing the photoglass. Architectural glass manufactured by this process cover the sides of the United Nations Building.

The lamps are also used in photo-printing and blacklight where a point source is necessary to control the light patterns accurately. Recent developments have also seen the use of this lamp for microfilm printers and for sensitizing "photoresist" materials.

To date, mercury-xenon short arc lamps, because of their quick warm-up, high brightness, long life, and practically maintenance-free operation, have been used primarily in military searchlights to replace incandescent and carbon arc lamps. As a result of these advantages, plus the low lamp operating cost of approximately $1.00 an hour, it is inevitable that mercury-xenon lamps will find their way into many existing searchlight installations, especially those on inland waterway vessels. This same economic advantage applies to the straight mercury type, which is seriously being considered for use in the highly competitive publicity searchlight field.

Undoubtedly, the short arc lamp will continue to find its place in those installations which require high brightness from a point source hermetically sealed in a long-life, clean-operating bulb type light source.

References

1. Freeman, G. A.: "Short Arc Mercury Lamps," ILLUMINATING ENGINEERING, Vol. XLV, p. 218 (1950).
2. Thouret, W. E., and Gerung, G. W.: "Xenon Short Arc Lamps and Their Applications," ILLUMINATING ENGINEERING, Vol. XLIX, No. 11, p. 520 (1954).
3. Aldington, J. N.: "Bright Light Sources Part II," *Transactions Illuminating Engineering Society London*, Vol. II, p. 11 (February 1946).
4. Thouret, W. E.: "New Designs of Quartz Lamps," *Licht-Technik*, Vol. II, p. 73, 107 (1950).
5. Fraser, H. D., U. S. Patent #2,682,009 (June 22, 1954).

Report on the 1956 National Technical Conference

A complete report on the 1956 Conference in Boston, with photographs of the major events, awards and special Golden Anniversary doings appears in the Lighting News Section of this issue.

INSTALLATION AT
A. S. BECK
SHOE STORE
6015 PENN AVE.
PITTSBURGH, PA.

Lighting a Shoe Store

LIGHTING OBJECTIVE: To provide a high level of illumination and a pleasant atmosphere for selling shoes.

GENERAL INFORMATION: The sales area shown above measures approximately 81 feet by 23 feet 6 inches. The ceiling height is 11 feet 8 inches. Colors and reflectances are as follows:

ceiling	light green	50% RF
walls	cream	60% RF
shelf fronts	light oak	33% RF
floor		
rubber tile	cream and red	50% RF
carpet	red	7% RF
showcase trim	light oak	33% RF
illuminated display case frame	light oak	33% RF
chairs		
men's department	red	10% RF
ladies' department		
seats	cream	50% RF
arms and legs	mahogany	20% RF

INSTALLATION: Fig. 2 is a plan view of the shoe store sales area showing the location of all lighting equipment, including the number and type of lamps used in each luminaire. Fig. 3 is a cross-section detail of the illuminated valances over the shoe shelves.

Illumination values are as follows:

average general (horizontal 36 inches above floor)	68 ft-c
average under illuminated canopy (horizontal 36 inches above floor)	100 ft-c
on men's department display rack (vertical 7 feet above floor)	60 ft-c
on counter top (horizontal 39 inches above floor)	100 ft-c
showcase behind counter (vertical)	
top shelf	45 ft-c
second shelf	35 ft-c
third shelf	25 ft-c
bottom shelf	25 ft-c

(over)

A.I.A. File No. 31-f

Lighting a Shoe Store (Continued)

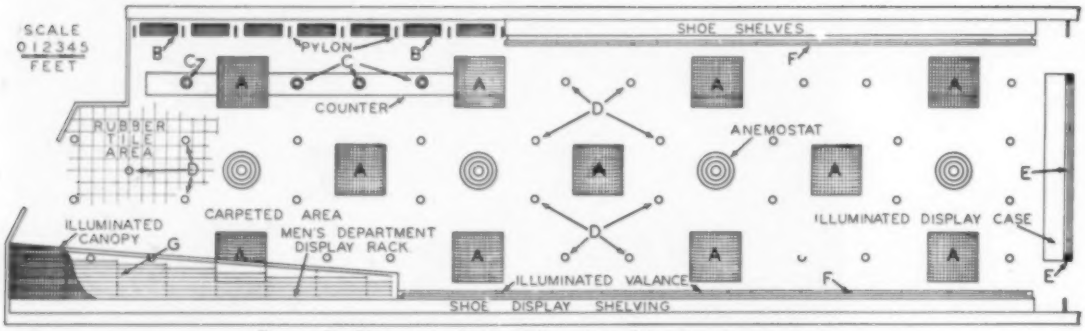


Figure 2. Plan view showing location of lighting equipment.

A — Eleven 4 x 4-foot recessed louvered fluorescent luminaires, Ruby-Philite catalog No. 2828-8/48. Each is equipped with eight 40-watt T-12 standard cool white preheat starter type lamps.

B — Seven recessed louvered fluorescent luminaires, Ruby-Philite catalog No. 7062-4/36. Each is equipped with four 30-watt T-8 standard cool white preheat starter type lamps.

C — Four suspended incandescent luminaires, Litecraft catalog No. 201 with rigid stem. Each is suspended five feet from the ceiling and is equipped with one 150-watt R-40 reflector floodlamp.

D — Thirty-four recessed incandescent luminaires, Ruby-Philite catalog No. L-4055. Each is equipped with one 150-watt R-40 reflector floodlamp.

E—Two (one top and one bottom) 14-foot strip lights each containing: one Ruby-Philite catalog No. SL8002-2/96 equipped with two 96-inch T-12 standard cool white slimline lamps; one catalog No. 8002-2/48 equipped with two 40-watt T-12 standard cool white preheat starter type lamps; and one catalog No. 8002-2/24 equipped with two 20-watt T-12 standard cool white preheat starter type lamps.

E′ — Two (one each side) 10-foot strip lights each containing one Ruby-Philite catalog No. SL8002-2/96 and one No. 8002-2/24 equipped as in E.

F — One 50-foot strip light containing twelve Ruby-Philite catalog No. 8001-1/48 luminaires each equipped with one 40-watt T-12 standard cool white preheat starter type lamp, and one catalog No. 8001-1/24 luminaire equipped with one 20-watt T-12 standard cool white preheat starter type lamp.

F′ — One 42-foot strip light containing ten Ruby-Philite No. 8001-1/48 and one No. 8001-1/24 equipped the same as in F.

G — One trapezoidal shaped louverall assembly consisting of fifty-seven Ruby-Philite catalog No. 8001-1/48 and five No. 8001-1/24 equipped the same as in F.

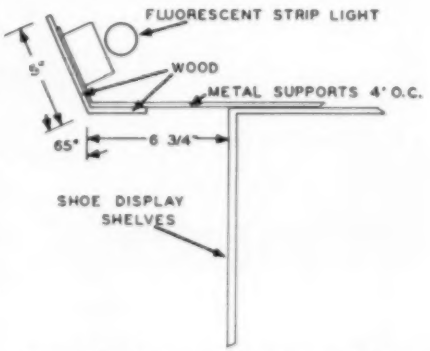


Figure 3. Cross-section detail of the illuminated valances.

Brightnesses are as follows:

square recessed fluorescent luminaires (at 45°)	480	ft-L	ceiling (between luminaires)	11	ft-L
recessed incandescent downlights (at 45°)	7000	ft-L	walls (above shelves)	55	ft-L
illuminated louverall canopy (at 45°)	230	ft-L	shelf fronts	9.5	ft-L
rectangular recessed fluorescent troffer (over show case behind counter, at 30°)	600	ft-L	floor		
			tile (near counter)	56	ft-L
			carpet	11.5	ft-L
illuminated glass display rack			showcase trim	8	ft-L
center	15	ft-L	chair seats		
near top	330	ft-L	men's department	15	ft-L
frame	15.5	ft-L	ladies' department	55	ft-L

Lighting designed by C. Specter, A. S. Beck Shoe Store Co., New York, N. Y. and installed by G. S. Walters Electrical Co., Middle Road, Glenshaw, Pa.

Lighting data submitted by Armand Zitelli, Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Enginering Society, 1860 Broadway, New York 23, N. Y.

Flashing Characteristics Of Fluorescent Lamps

By J. H. CAMPBELL
D. D. KERSHAW

UNTIL RECENTLY the filament lamp and cold cathode tubing were the only light sources available to the sign industry for flashing service. It is the purpose of this paper to show how rapid-start hot cathode fluorescent lamps can now be flashed millions of times without sacrificing lamp life or other advantageous performance characteristics.

The inherent ability of the ordinary filament lamp to take any on-off cycle without seriously impairing its rated life provided a natural light source for the sign manufacturer. When the fluorescent lamp became available for general use, we had the advantages of much higher efficiency in all colors, lower brightness, better lumen distribution and longer life. As a consequence, sign manufacturers were attracted to this new lighting tool. However, it soon became common knowledge that the hot cathode fluorescent lamp could not be flashed without drastically reducing its rated life. Therefore, only signs designed for on-off periods of several hours were economically feasible.

Many attempts were made to devise circuits which would allow flashing. In 1947, F. J. Vorlander presented a paper[1] to the Illuminating Engineering Society in which he described a circuit for flashing preheat lamps. Lamps were operated on instant start ballasts with continuous preheat applied by means of separate transformers. A lamp life of several million flashes was reported. According to his paper, satisfactory lamp life depended upon a critical cathode voltage — a value just under the ionizing potential of the cathode. This would have been difficult to accomplish without an elaborate voltage regulator since normal fluctuations in line voltage would increase or lower preheat voltage from the critical value.

Development of the first fluorescent dimming system[2,3] provided the basis for a practical flashing ballast. The dimming circuit required continuous preheat of the cathodes in order to obtain proper cathode temperatures for electron emission over the full range of arc current (425 milliamperes to approximately 3 milliamperes). The rapid-start lamp provided the advantage of optimum cathode temperature with low preheat voltage and relatively small preheat windings. Subsequent tests showed that lamp life is normal even when lamps are operated continuously at low arc current levels.

In view of the successful operation of lamps in the dimming system, a life test was started in which a motor-driven two-contact switch was placed across the control lead and upper primary lead of the dimming ballast. A cyclic variation of five seconds on and five seconds off was set. The test was discontinued at four million starts, but the first lamp to fail had only 40 thousand starts and additional tests were scheduled to determine the cause of the wide variation.

Starting Characteristics Of Rapid Start Cathodes

It is well established that the life of any fluorescent lamp with conventional ballasts is materially affected by the number of times it is started. An instant-start lamp has cathodes designed to withstand the heavy ion bombardment required to bring the cathode to emissive temperature. This is accomplished by winding a fine tungsten wire over the coiled filament. Since the fine wire presents a low mass, it heats quickly, reducing the destructive ion bombardment at the cathode. Even this design may not provide rated lamp life with more than one start for every three hours of operation.

If a fluorescent lamp is to be flashed at a rapid rate, means of reducing deteriorating starting effects on the cathode must be provided. The use of a rapid-start lamp with the proper continuous preheat allows a more favorable starting condition thus minimizing the stripping of emission material.

Fig. 1 illustrates an unusual electrical characteristic which can be observed during the first few cycles of lamp operation. The oscilloscope picture was taken on a 40-watt rapid-start lamp (a probe was employed to measure cathode gradient) with

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 17-21, 1956, Boston, Mass. AUTHORS: General Electric Co., Large Lamp Dept., Advance Engineering, Nela Park, Cleveland, Ohio.

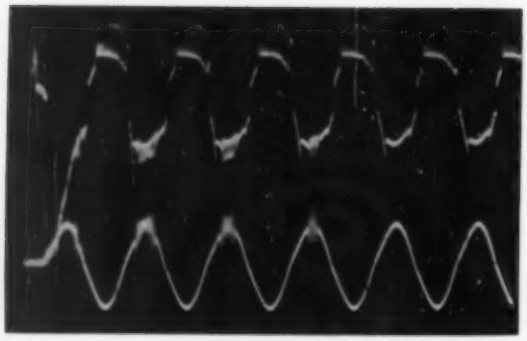


Figure 1. (Upper photo) Cathode fall voltage with 3.5 volts applied showing radio frequency component. (Lower photo) Arc current with 3.5 volts applied to one cathode, 4.5 to the other.

one cathode heated by application of 4.5 volts and the other by application of 3.5 volts. Both traces were taken simultaneously with an electronic switch so that Figs. 1A and 1B are identical with respect to time. Fig. 1A represents the cathode fall with the lower portion of the trace indicating the cathode half cycle and the upper part the anode oscillations. Fig. 1B illustrates the arc current. The voltage and current waveshapes have a superimposed high frequency (several megacycles) component which occurs for a number of cycles depending on the static temperature. (Static temperature will be referred to throughout the paper and denotes the continuous preheat temperature with no arc current flowing.) It is noted that only one-half of the current waveform has the high frequency component. This is because one cathode has 4.5 volts while the other one is operating at a temperature equivalent to 3.5 volts. The higher cathode preheat voltage increases the static cathode temperature to a value such that the electrons are supplied to the plasma with a minimum of cathode fall.

In examining the starting conditions under which the cathode is receiving considerable ion bombardment, the preheat was varied from two to five volts. The resulting data showed that the high frequency component existed for a greater number of cycles prior to formation of the hot spot as the cathode voltage was decreased. The high frequency component is important only as it correlates with the damage occurring at the cathode over a range of cathode temperatures. This observation along with other data showed remarkable correlation of the effects of static cathode temperatures on flashing life.

A possible explanation of the high frequency disturbance during the initial starting period is related to the inability of the cathode to provide a required degree of emissivity over the cathode half cycle. If the static cathode temperature is too low, the cathode fall is increased during the first few cathode half cycles. As a result of the high fall, the cathode is bombarded by higher energy positive ions causing an increase in emission coating temperature. The hunting action of the arc while the cathode is endeavoring to regulate a constant supply of electrons results in random changes of cathode fall (Fig. 1A).

Depending upon the past history of a given cathode and the static temperature under which it was started, the surface of the emission coating develops three conditions which can be associated with the high frequency component.

(1) If the cathode fall is high due to inadequate static cathode temperature, the positive ion bombardment will produce a surface having an excess of free barium. In successive starts this spot is generally more active until the available barium is evaporated due to excessive coating temperatures.

(2) Continued flashing of a fluorescent lamp with inadequate preheat produces a small spot or spots on the cathode surface, indicating a chemical change. These small areas which have a dark gray appearance develop a fairly high work function. A simple test on the surface of the cathode entailed the use of a small quantity of water on a blackened cathode which resulted in the evolution of acetylene gas. From this observation it would appear that barium carbide represents at least part of this chemical change.

(3) In Fig. 2A to be described later it is noted that the temperature of the emission coating is abnormally high during the first few cycles of a lamp operated instant-start. This extremely high emission coating temperature is a result of the intense ion bombardment during the high cathode fall. If a lamp is subjected to a relatively large number of starts with insufficient static cathode temperature, the intense ion bombardment coupled with the high coating temperature causes the cathode to go through the conditions described above in 1 and 2.

In order to investigate further the damage done to the cathode during the starting period, the region near the cathode was examined spectrographically. At low values of cathode temperature the cathode fall is high initially and the barium lines are present for a considerable number of cycles. As the preheat voltage is increased the persistence of the lines becomes shorter. With approximately four volts applied to a 40-watt rapid-start cathode the loss of barium due to ion bombardment and the high temperature of the emission coating is greatly

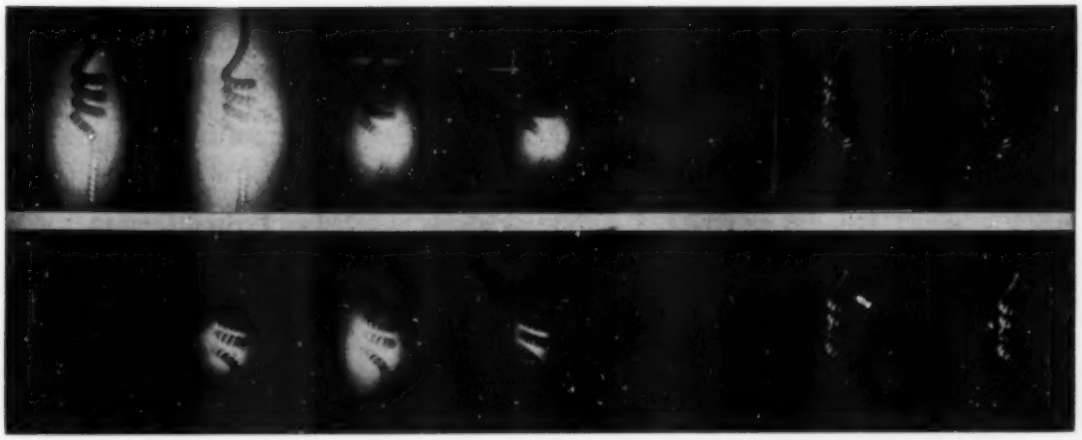


Figure 2. (Upper photo) Shows instant starting of a rapid-start cathode in the first complete cycle. Hollow cathode effect causes sputtering and loss of active material. Ion bombardment causes high coating temperature which is carried over to anode half cycle. (Lower photo) Shows the same cathode starting in the first complete cycle with 4.5 volts applied and a minimum of destructive action.

reduced. These are data in agreement with the oscillographic studies of the cathode fall and corresponding high frequency component. It should be emphasized that either spectral examination or the electrical measurement of the high frequency disturbance depends to a great extent on the previous starting history of the cathode. If a lamp has been started under unfavorable conditions, the surface of the cathode may become blackened as mentioned in Item 2. Under these conditions it is possible that barium lines may be observed even though the cathode has a preheat of five volts.

A series of high-speed movies (1000 frames per second) were taken on a 40-watt rapid start cathode with various values of cathode temperatures. The static cathode temperatures were examined over a range from room temperature to 950C. Fig. 2B was taken with 4.5 volts on the cathode providing a minimum of damage to the emission coating. Both photos, Figs. 2A and 2B, show the cathode at seven points in one complete cycle. Fig. 2B illustrates the uniform establishment of the arc at the cathode. It can also be observed that the emission coating temperature is low during the anode half-cycle. Fig. 2A represents the extreme condition of instant-start (no cathode preheat) and illustrates the hollow cathode condition with re-occurring sputtering of active material and intensive ion bombardment. This is particularly noted in the hot spots on the emission coating carried over into the anode half cycle. However, complete viewing of the film shows that the high emission coating temperature is reduced and a stable cathode spot is established after several cycles of continuous operation.

Cathode Temperature Requirements

Through the experimental methods described previously and comprehensive life tests, the proper cathode temperatures for successful flashing life were established. Fig. 3 illustrates the static temperatures produced with various preheat voltages for the high and low current rapid-start lamps. Because of the difference in the construction of the cathodes, the high current lamp requires less preheat voltage for a given temperature than the low current lamp. Life test data indicate that the *minimum* cathode preheat voltage for the 40-watt rapid-start lamp is approximately four volts plus or minus 0.25 volt. The high current rapid-start lamp requires 3.4 volts plus or minus 0.25 volt to satisfy minimum flashing life conditions. At these minimum values mentioned, the flashing life increases one hundredfold over cathode voltage values only slightly lower.

A typical example of the effect of preheat voltage is illustrated in Fig. 4. This photo shows the cathode removed from a 40-watt rapid-start lamp. The cathode shown in the upper photo was operated at 4.5 volts, whereas the cathode in the lower photo was operated at 3.5 volts (standard cathode voltage conventional operation). The lamp had been flashed at a rate of one second on and one second off for a period of three hours. At the end of this time a noticeable distortion in the lamp current waveshape was noted during one-half of the cycle. This was due to the loss of barium and chemical changes at the cathode surface of the lower cathode. These changes at the cathode surface increase cathode fall causing a progressive destruc-

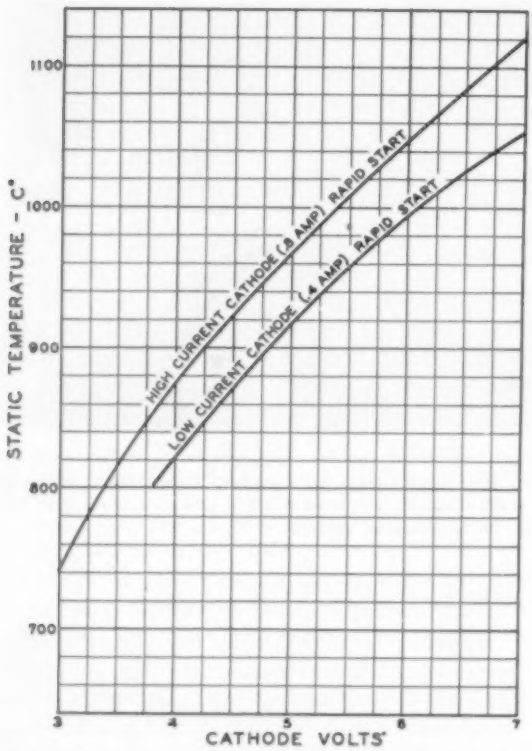


Figure 3. Average cathode temperatures versus cathode preheat voltage measured with an optical pyrometer.

tion of the cathode by increased ion bombardment. This cathode (lower cathode, 3.5 volts) would have been completely destroyed in 10 to 20 hours as indicated in preliminary life tests on this flashing cycle. However, at the time of the photograph, it is not completely damaged; the emission coating surface could have been restored to normal by operating the lamp with optimum preheat voltage.

Cathodes, Ballasts and Line Voltage Tolerances

In order to achieve an economical flashing life, the variations from design center in cathode and ballasts must be considered. The curves represented in Fig. 3 are average cathode temperature values for a large number of lamps tested. In actual practice the cathode will have a variation in temperature due to manufacturing tolerances equal to plus or minus 0.25 volt.

The manufacturers of ballasts also require a leeway of plus or minus 0.25 volt as a production tolerance. Line voltage variations coupled with the above mentioned factors must be included in the specifications for cathode voltages in flashing applications. Specifications for the 40-watt rapid-start lamp at rated line voltage are 4.5 to 5 volts with a design center of 4.75 volts. The high current lamps should be designed to operate at normal line voltage with a cathode heating voltage of 3.8 to 4.3 with the center at 4.05 volts.

Flashing of Standard Preheat Lamps

The question arises regarding the use of preheat lamps for flashing service. It follows from the preceding data that if any cathode is preheated to the correct temperature with proper open circuit voltage applied, flashing life may reach an economical point. However, the rapid-start lamps with cathodes designed for low voltage preheating provide the smallest and lowest cost ballast. Ballasts for flashing preheat lamps would necessarily have to be designed for a preheat voltage approximately 1¾ times that of rapid-start flashing ballasts. It should be noted that rapid-start cathodes with triple coil construction provide starting conditions much more favorable for flashing service than preheat type cathodes. From previous tests it appears that flashing life of rapid-start lamps will be from three to four times greater than preheat types.

Lumen Maintenance

One of the interesting facts resulting from the long series of life tests on flashing lamps is that lumen depreciation is not increased by the frequency or total number of flashes within practical

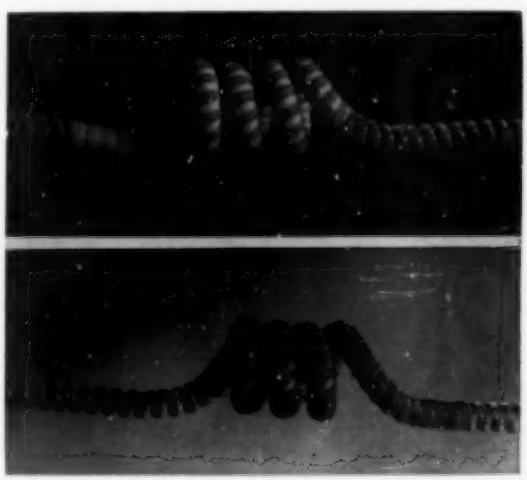


Figure 4. Cathodes taken from the same 40-watt rapid-start lamp operated for three hours on a one second on, one second off flashing cycle. (Upper photo) Shows normal condition of cathode when operated at 4.5 volts preheat. (Lower photo) Shows contamination of cathode due to marginal operation on 3.5 volts.

TABLE I — Flashing Life Test Data.

Test No.	1	2	3	4	5	6	7	8
Lamp Type	40-w R.S.	40-w R.S.	40-w R.S.	40-w R.S.	40-w R.S.	40-w R.S.	48" R.S.	72" R.S
Ballast Type	Fig. 5A	Fig. 5A	Fig. 5A	Fig. 5A	Fig. 5A	Fig. 5A	Fig. 5O	Fig. 5O
Preheat Voltage	3.5	4.0	4.5	4.5	4.5	6.5	4.1	4.1
Flashing Cycle (sec. on & off)	1 & 1	1 & 1	1 & 1	½ & ½	4 & 1	1 & 1	1 & 1	1 & 1
No. of Flashes	86,000 to 250,000	1,411,000	15,300,000	30,600,000	4,040,000	1,710,000	8,771,000	8,771,000
Hrs. of "On" Time	14	784	4,250	4,250	4,492	475	2,436	2,436
Total Cycle Hrs.	28	1,568	8,500	8,500	5,615	950	4,873	4,873
Avg. End Discoloration	Poor	Fair	Good	Good	Good	Poor	Good	Good
Avg. Cathode Condition	Poor	Fair	Good	Good	Good	Good	Good	Good
No. of Failures	10 out of 10	1 out of 10	None	None	None	None	None	None
Status	Completed	Still in Progress	Still in Progress	Still in Progress	Still in Progress	Still in Progress	Still in Progress	Still in Progress

application limits. In fact, the data indicated that the lumen maintenance might possibly be improved by a factor of one or two per cent. It is entirely possible that the slight gain in lumen maintenance is due to the continuous application of an elevated cathode heating voltage which would minimize the loss of barium.

The use of ballasts designed for flashing service would result in early end discoloration of the lamps if operated on the conventional burning cycles. The increased cathode temperature in addition to the heating effect of the arc current if applied for long flashing periods (two minutes on and two minutes off) shows a slight end discoloration. However, tests to date indicate that flashing life will not be materially affected. In typical sign operations the flashing cycles will be of the order of one-half second to five seconds of burning time.

Life Test Results

Some 32 individual life tests consisting of ten lamps each were intiated to determine flashing life. The following variables were studied to determine their effects on flashing lamp life: (1) cathode voltage, (2) cyclic flashing rate, (3) type of ballast circuit.

Cathode Voltage

A series of tests at 0.25-volt steps were made on both the high and low current rapid start lamps. These data indicated that best performance will be obtained with 4.75 volts for the low current rapid-start lamp and 4.05 volts for the high current rapid-start lamp. Since all of the tests at this period are still in operation, it is difficult to state the ultimate life.

Table I shows a partial resume of some of the flashing life tests. The actual number of flashes on the various tests depends on the flashing cycle and how long the test has been operated. The table illustrates that the cathode heating voltages affect the ultimate flashing life to a greater extent on the low side of the design center than they do on the high side. Below four volts the flashing life is limited to somewhat less than 30 hours. However, if the cathode is subjected to extremely high cathode preheat (Test No. 6), the flashing life may be somewhat reduced. With cathode preheat values higher than design center, the bulbs will show evidence of early end discoloration, but the cathode remains in good condition. While some reduction in lamp life will occur when the cathodes are operated at voltages greater than design center, the present tests are not completed and it is difficult to predict the exact amount.

Effects of Circuits on Life Test

Several types of ballasts designed for flashing fluorescent lamps were investigated to see if any one particular type of circuit affected lamp life adversely. The ballasts tested including a single-lamp lag and a two-lamp series lead are giving equal performance to date.

Flashing Circuits

A number of circuits for flashing rapid-start lamps were designed for this special application. Fig. 5A illustrates the single-lamp type. Schematically this circuit is the same as used for dimming but with preheat coils arranged to provide voltage to the cathodes commensurate with life test results. The circuit operates as follows: When line voltage is applied, cathodes are heated to the optimum value for electron emission. When the flasher contacts are closed, open circuit voltage sufficient to start the lamp is applied. When contacts are opened, the arc current drops to zero, but cathode preheat remains, thus preparing the lamp for the next cycle. Th capacitor across the lamp is chosen for a value to suppress the small amount of radio noise common to all fluorescent lamps. Capacitors for suppressing radio noise are included in other ballast designs, but are not shown in the schematic diagrams.

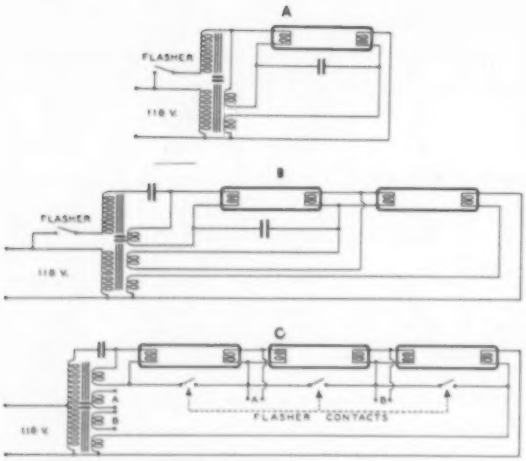


Figure 5. Flashing lamp ballast circuits.

A — Single lamp
B — Two-lamp series sequence
C — Three-lamp series sequence

Fig. 5B illustrates the series sequence lead circuit for flashing two lamps. The capacitor shunt across one lamp enables the second lamp to receive full open circuit voltage. This lamp then draws current at a value determined by the impedance of the shunt capacitor. The first lamp then receives the peak voltage of the capacitor and full arc current is established in both lamps. This action takes place rapidly enough to allow any practical flashing cycle. This circuit results in a smaller, lower cost ballast as in the case of other series sequence ballasts designed for general use.

Fig. 5C shows a three-lamp series sequence circuit in which the contactors are shunting the lamps. This circuit provides considerable flexibility since any one or more lamps can be turned on or off progressively. The ballast design differs from other flashing ballasts in that the lamps are shorted in order to turn them off. In an arrangement of this type, the transient voltage developed when an individual contactor is opened supplies the lamp with a starting voltage equal to 1.5 to 2.0 times the open circuit of the transformer. Because of the reduced open circuit voltage of this design, the ballast is smaller in cubic content per lamp and the cost per lamp is less than a two-lamp series circuit. The three-lamp sequence ballast provides a minimum power factor of 80 per cent regardless of whether one, two, or three lamps are operating. This is accomplished by adjusting the ballast to allow an 80 per cent lagging power factor with three lamps on and approximately an 80 per cent leading power factor with one lamp on and two lamps shorted. The main limitation on this circuit is the use of one pair of contacts for each lamp, whereas other circuits have a common contactor for large numbers of lamps.

Ballasts have been designed with the circuits of Fig. 5 for low current and high current rapid-start lamps and for indoor or outdoor operation. Outdoor application requires a higher open circuit voltage for low temperature starting.

During the preliminary flashing life test a resistor was placed across the contactor on half of the lamps in order to leave a low level of current in the arc during the "off" cycle. Since the lamp was never completely deionized, starting of each lamp on each cycle was assured even though the flashing was set for periods of as low as one-half second. It was observed that an occasional lamp failed to start in the group where this resistor was not used. It is therefore recommended that a resistor of the value needed to maintain the arc during the off period be used for signs designed for indoor service. The higher open circuit voltage of outdoor signs will generally insure rapid re-starting without the resistor.

Conclusions

Availability of lamps, circuits, and ballasts for flashing service has resulted in a new and comparatively large application for fluorescent lamps. The well-established medium of advertising by means of lighted signs now has an additional and advantageous means for conveying messages to the public.

The foregoing test data are reported to illustrate lamp and circuit requirements and to serve as a guide to ballast manufacturers and users of fluorescent flashing systems. Future developments in lamps and circuits will undoubtedly provide even more flexibility and additional advantages. A watchful eye will be kept on possibilities for improving this new lighting tool.

Acknowledgement

The authors wish to acknowledge the fine cooperation of Miss M. A. Easley and her technical assistance during our many discussions of cathode phenomena.

References

1. Vorlander, F. J.: "Repetitive Flashing of Hot Cathode Fluorescent Lamps," ILLUMINATING ENGINEERING, Vol. XLIII, No. 9 (September 1947).

2. Campbell, J. H.; Schultz, H. E.; and Abbott, W. H.: "Dimming Hot Cathode Fluorescent Lamps," ILLUMINATING ENGINEERING, Vol. XLIX, No. 1 (January 1954).

3. Kershaw, D. D.: "Variable-Reactance Dimming Control for Fluorescent Lamps," *Electrical Engineering*, Vol. 74, No. 5 (May 1955).

Flashing Applications Of Fluorescent Lamps

By R. W. BUNNER
R. T. DORSEY

IN THE LAST few years fluorescent lamps have come into wide use in the electrical advertising field. Their high efficiency in producing white, colored, and black light; long life (7500 hours for most types); ready availability; a wide variety of lengths; and high light output per foot are among the reasons for their popularity. Moreover, a linear source makes it easy to get uniform brightness of luminous elements and is desirable for lighting poster panels and some forms of building floodlighting, as well as silhouette signs and store front lighting.

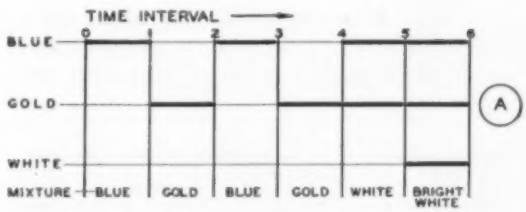
As with any widely used electrical advertising technique, distinctiveness in shape, pattern, size, brightness, color, and animation is needed to enable one sign to stand out from its neighbors. Size and shape requirements led to the introduction of slimline lamps in the shorter lengths to make a complete line from 2 to 8 feet. The development of flashing of rapid-start lamps[1] has made practical a whole new range of effects.

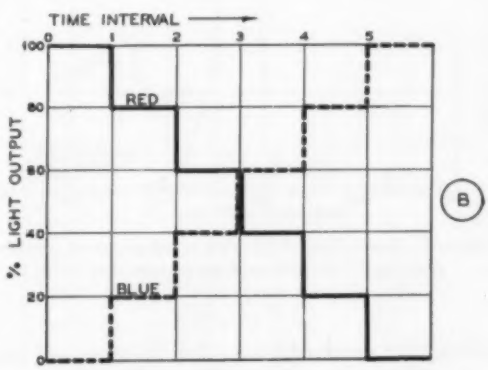
The purpose of this paper is to review possible applications where fluorescent lamps can be flashed to advantage, and practical methods of doing it.

Flashing Sequences

Simple on-off effects with incandescent lamps and cold cathode tubing have been used for years, and such considerations as flashing rates in terms of viewing time are well established. A modification of this is the switching of one lamp to another. Changes in brightness pattern such as "wiping" and "curtain" actions can thus be obtained.

These actions involve simply turning the lamps on and off. In addition, there are opportunities in step-flashing and dimming. See Figs. 1, 8, 9. By these means, more subtle effects can be created that will be more acceptable for many applications. Fig. 1 indicates a few of the unlimited sequences that can be applied.





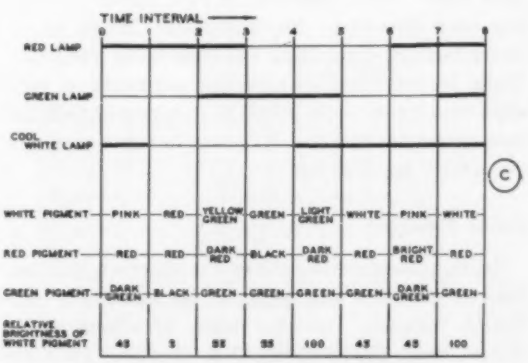


Figure 1. Three flashing sequences.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 17-21, 1956, Boston, Mass. AUTHORS: Ballast Engineering Section, Ballast Dept., General Electric Co., Danville, Ill.; and Application Engineering, Large Lamp Dept., General Electric Co., Cleveland, Ohio, respectively.

Complementary Color Effects

Switching from one color to another is the subject of much current interest. It presents the opportunity for dramatic changes in familiar trademarks and monograms. However, since many advertisers prefer to maintain the color and shapes of designs in which they have invested large amounts of advertising, there is more activity in creating entirely new designs. The underlying principles involved have been recognized for many years.[2]

Consider first the relationship between a green fluorescent lamp and a red pigment. From Fig. 2 it can be seen that the pigment has practically no transmission (or reflection as the case may be) of the wavelengths emitted by the lamp. Thus the result would be a very dark color whose energy distribution is shown by the cross-hatched area. Similar effects can be produced with other complementary combinations — for instance, red lamp — green pigment, blue lamp — yellow pigment, gold lamp — blue pigment. A new deep-blue color has been developed for fluorescent lamps which emits less red light than the blue lamp (Fig. 3). Thus, in combination with red pigments, a very dark result can be obtained. It is expected that the new deep-blue will find wide use in other sign and decorative applications.

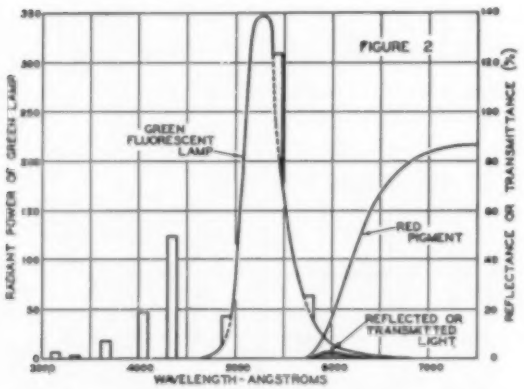


Figure 2. Green light falling on a red pigment produces practically no reflected or transmitted light.

Color Changes

In the above combinations the spectral distributons of the lamp and pigment are essentially mutually exclusive. Another series of effects would result from distributions that overlap. In these cases a color change would be achieved rather than a "blackout." Other combinations include mixing colored light as in Fig. 1 (C).

Fadeout Effects

Consider next the relation between a light orange-red pigment on a white background (Fig. 4) and a red fluorescent lamp. It will be noted that the red pigment and the white background both reflect or transmit nearly the same percentage of the wavelengths emitted by the red lamp. As a result, the red pigment would tend to disappear. A similar effect will be produced with red or gold lamps on a yellow pigment. With green or blue pigments, usually the reflectance (or transmittance) at any wavelength is well below that of a white material. This makes "disappearing" effects difficult, but changes in emphasis can be achieved.

Through combinations of the effects in the above two paragraphs, signs can be made visually to change shape, dual messages can be portrayed, patterns, texture, and line can be changed. An indication of the possibilities is shown in Fig. 5. The principles apply for reflected light, as well as by transmission. Thus the above technique can be used for poster panels, bulletins, and building floodlighting as well as luminous elements.

Lighting Design

From the standpoint of sign lighting design, the factors of brightness, lamp output, overall efficiency of the sign, uniformity of brightness, and flashing cycles are among those to be considered.

As to brightness, the *IES Lighting Handbook*, Second Edition (page 11-13), lists recommendations for various types of elements and for low, medium, and high brightness districts. For luminous-background signs, the values range from 80 to 400 footlamberts.

As an example, to produce 350 footlamberts maintained in service on a double-faced enclosed sign 3 feet x 4 feet would require 10,000 lumens generated based on 70 per cent efficiency of the sign (50 per cent transmission diffusing white plastic faces) and 60 per cent maintenance factor. Thus four F40T12/CW/RS lamps would be adequate. However, if substantial areas of the faces are colored, or if colored lamps are used, larger numbers of lamps, or lamps of higher output are required to maintain effectiveness. The lumen outputs of various colored lamps given in Table I indicate the magnitude of this factor. Thus, the development of the high-output rapid start lamps was of immediate interest. While the increase of 40 per cent in lumens per foot in these lamps is an

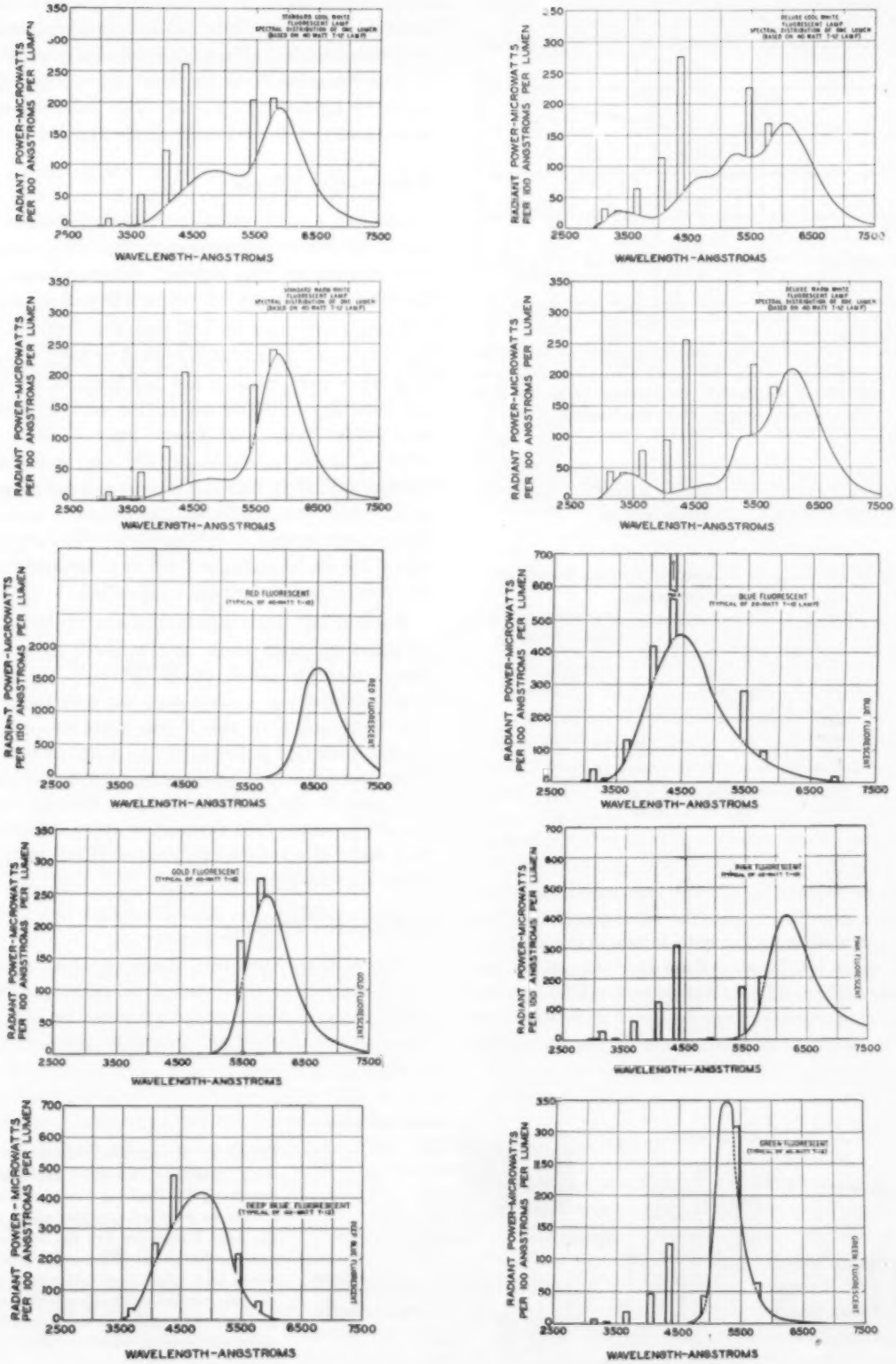


Figure 3. Spectral distribution curves of white and colored fluorescent lamps.

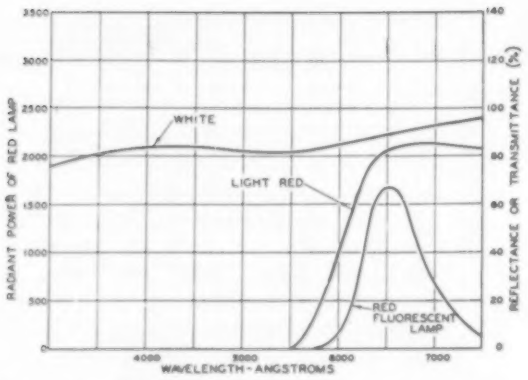


Figure 4. Where the spectral reflectances of two colors (white and light red in this case) are nearly the same, they will blend together if the energy from the light source is restricted to this region.

important gain, still higher output is needed — particularly in the saturated colors.

TABLE I — Light Output of Various Colors of Fluorescent Lamps.

Fluorescent Lamp Color	Approx. Initial Lumens
Standard Cool White	2500
Standard Warm White	2600
Deluxe Cool White	1840
Deluxe Warm White	1840
Daylight	2325
Red	150
Pink	1125
Gold	1470
Green	3000
Blue	1125
Deep Blue	380

As to uniformity of brightness, the usual desire is for a smooth tone over the whole sign face. Typically, the distance between lamps is one and one-half times the distance from the lamp to the face. When using more than one color it will be apparent that, to accomplish this, lamps of each color must be suitably spaced in relation to the face. Since this multiplication of lamps causes space and cost problems, often the solution is a compromise on uniformity of brightness, or deliberately creating a variation. For example, one part of the sign could be lighted continuously and color changes introduced in the remainder of the area.

Temperature Effects

Another consideration is the performance of lamps with varying temperature. Much has already been written on this subject. However, some of the recent data in the sign field will be helpful.

Preliminary tests on a 3 foot x 6 foot double-faced enclosed plastic sign typical of high production types were made in the low-temperature testing labortory in which the earlier work of Forbes and Diefenthaler was done.[3] Four 64-inch T12 slimline lamps operated at 430 ma were used. Results indicated that the sign face brightness at zero F with practically no draft was the order of 35 per cent of that at 80F ambient. No data were taken for draft conditions, but it is expected that this would have relatively little effect.

Another test was conducted on the 72-inch high-output rapid-start lamp in a reflector such as is being used for poster panel lighting. When enclosed by putting a cover over the reflector opening, light output at zero F was about 20 per cent higher than at 80F under no-draft conditions. When no cover was used, light output was about the same at the two temperatures with no draft. However, recent field experience shows that drafts will materially reduce light output at low temperatures if no cover is used.

Ballasts for Flashing

New ballasts have been designed which operate rapid start fluorescent lamps in flashing service. Flashing applications using standard ballasts and line interruption will not provide satisfactory lamp

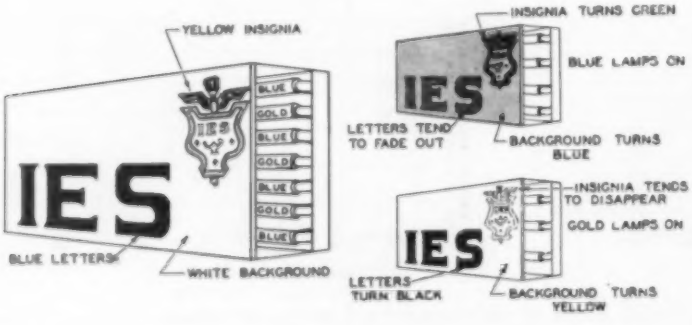


Figure 5. Spectacular changes in pattern, emphasis, texture, etc. can be produced by flashing from one color circuit to another. In this case, when the blue lamps are on, the emblem is are on, the letters IES are most prominent; and when both circuits are on, the mixture of light is normally white, giving colors their normal appearance. most prominent; when the gold lamps

life. The new ballasts provide special rated filament voltages that are continuously maintained during the flashing cycle. The lamp current, only, is interrupted to provide the flashing effect.

Ballast and Lamp Circuits

A typical circuit connection for single-lamp, low power-factor flashing operation is shown in Fig. 6. The ballast filament windings are wound over the primary coil which is continuously connected to the line. The close coupling of these coils provides continuous cathode heating. The ballast extension winding is isolated from the primary winding by a green-and-yellow lead connection. The flasher contactor is connected between the black and the green-and-yellow leads. The flasher contactor can

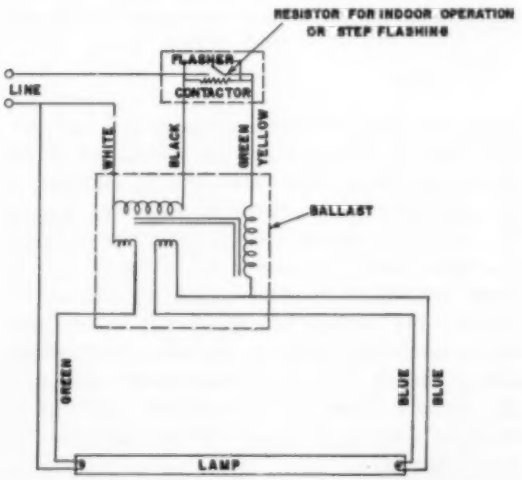


Figure 6. Circuit for flashing one 40-watt rapid-start fluorescent lamp.

interrupt the lamp current as needed to provide the flashing effect.

Two-lamp series ballasts can also be made for flashing two lamps at the same time. Fig. 7 shows this type connection which follows the same basic operation as does the single lamp unit except that the two lamps start in sequence.

Ballast Design

Ballasts must be designed for the lamp combinations and the lamp starting conditions desired. Reference 1 shows that good lamp life is obtained if 40-watt rapid-start lamps are operated with filament voltages of 4.5 to 5.0 volts. For high-output rapid-start lamps the range is 3.8 to 4.3 volts.

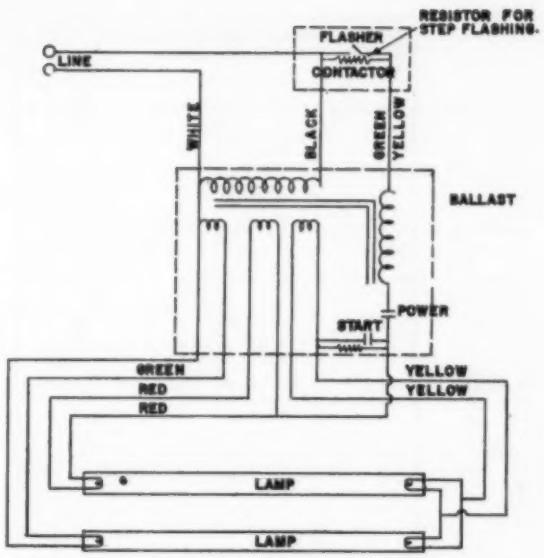


Figure 7. Series circuit for flashing two rapid-start fluorescent lamps.

These filament windings must be located in the ballast so that they are closely coupled to the primary windings and will be continuously maintained even when the lamps are in the off cycle.

The ballast open-circuit voltage must meet the lamp specification for the lamp, lamp combination and the lowest expected starting temperature for the application. Some ballasts are designed for single and two-lamp flashing operation of F40T12RS, F24T12RS, F36T12RS, F48T12RS, F64T12RS, F72T12RS, and F96T12RS lamps. Typical lamp ratings are 430 ma, 800 ma and 1.00 ampere.

In high power-factor series circuits for two-lamp operation it is noted that the lamps tend to flicker or reflash after the flasher contactor is opened and the lamps should be off. The discharge of the power capacitor and the starting capacitor supply energy to the lamps. In ballasts of current manufacture, a resistor is built into the ballasts to relieve this problem. (See Fig. 7.)

Ballast Enclosures

Ballasts for outdoor luminous signs are available in white-treated cases with junction boxes attached. These ballasts can be mounted in enclosed outdoor installations with conduit connections without additional ballast enclosure. The white finish is important in improving sign efficiency and reducing shadows. Rain-tight weatherproof enclosures are provided for pole mounting and poster panel installations.

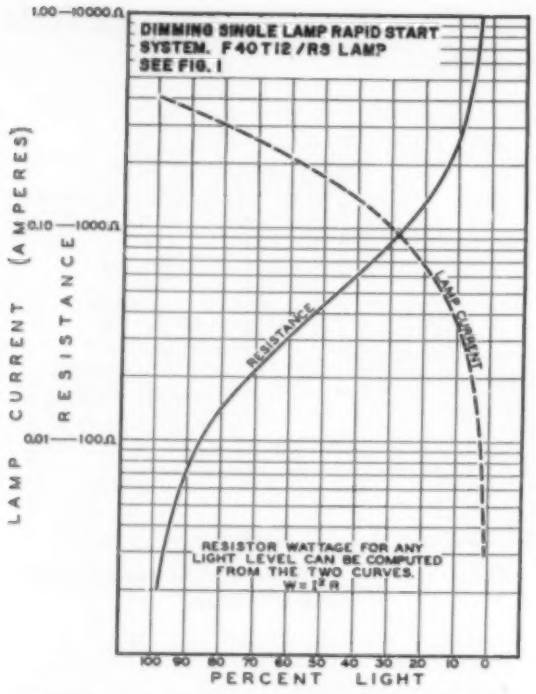


Figure 8. Resistor values to produce various lamp currents for the 40-watt rapid-start lamp.

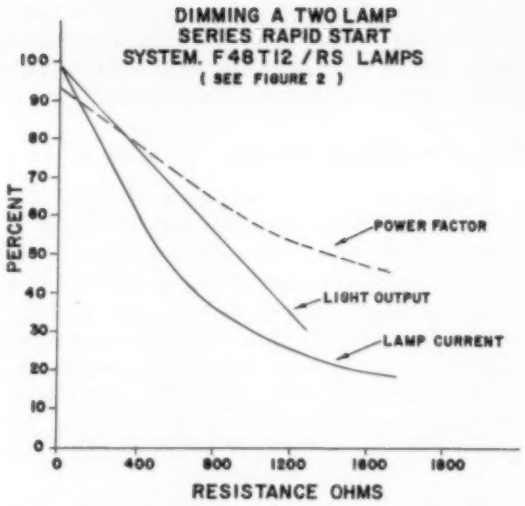


Figure 9. Resistor values to produce various levels of light output for the 48-inch high-output rapid-start lamp.

The standard black ballast with six-inch leads is suitable for indoor installation in acceptable channels. Also, this ballast is suitable in outdoor signs with suitable enclosure if the wiring is completed with weather-resistant #14 cable.

Industry Certification And Rating of Components

Underwriter's Laboratories listing for flashing rapid-start lamps has been obtained for suitability of combinations. External devices, flashing equipment, is to be used in conjunction with these ballasts which is the reason for the limited UL listing. The ballasts, to produce good service and long life, are designed to meet normal industry standards for light output and heating.

Ballasts connected as indicated must have flasher contactors rated as though the lamp is a short circuit. Due to inherent leakage resistances in the circuit and lamp combination and, in addition, to the distributed capacitance in associated wiring, the maximum voltage existing from the contactor to ground will be variable. The contacts must be rated for the total open circuit voltage of the ballast. The voltage to ground will be the open circuit secondary voltage or the line voltage, whichever is greater. Combined lamp current establishes the current rating of the contactor. Contactors must be designed to allow for the fact that the load is inductive.

Typical contactor ratings for ballasts available are given in Table II.

Circuits

Space does not permit a complete coverage of the many combinations of lamps, ballasts, and flashers that can be used. Following are some specifics that are important to mention.

For single-lamp indoor operation of the F40T12/RS a resistor across the flasher contacts is needed

TABLE II — Typical Contactor Ratings for Ballasts.

Lamps	Lamp	Ballast Open Circuit Voltage	Minimum Starting Ambient Degrees F	Maximum Volts On Contactor	Maximum Volts Contactor To Ground	Current Per Ballast Amp.
1	F40T12/RS	285	50°	285	167	.430
1	F40T12/RS	325	0°	325	207	.430
2	F48T12/RS	460	0°	460	342	.800
2	F72T12/RS	517	0°	517	399	.800
2	F96T12/RS	585	0°	585	467	.800

to assure reliable on-off flashing. Its value should be 35,000 ohms. This results in 1 per cent light output in the "off" part of the cycle. Fig. 8 gives intermediate resistor values as a function of light output. Where more than one lamp is used, an individual flasher contact and resistor is needed for each lamp.

For single-lamp outdoor operation of the F40-T12/RS, a resistor is not necessary for an on-off cycle.

For two-lamp operation of high-output rapid-start lamps, no resistor is necessary for an on-off cycle. Intermediate values of light output for the F48T12/RS can be obtained by using resistor values shown in Fig. 9.

Conclusion

Field experience on lamps, circuits, and ballasts for flashing rapid-start lamps is being gained. New ballast circuits are being investigated to improve this market — for example, the single ballast for independent flashing of three lamps.[1] The great appeal provided by flashing of fluorescent lamps indicates a new and exciting phase of the electrical advertising field.

References

1. Campbell, J. H., and Kershaw, D. D.: "Flashing Characteristics of Fluorescent Lamps," ILLUMINATING ENGINEERING, Vol. LI, No. 11 (November 1956).
2. Luckiesh, M.: "Color and Its Applications," 1915.
3. Forbes, J. W., and Diefenthaler, R. J.: "Temperature Characteristics of Fluorescent Lamps," ILLUMINATING ENGINEERING, Vol. XLI, No. 12 (December 1946).

Overhead Lighting For a Long Mirror

Side lighting was not feasible for the long mirror in this bathroom and, therefore, illumination for shaving and make-up is supplied by the overhead fixture. This fixture was built of wood by a carpenter, using venetian blind slats obtained from a local manufacturer. The light source consists of five 60-watt incandescent lamps mounted in porcelain sockets against the wall.

General illumination on the face is 35 ft-c with about 10 ft-c under the chin and eyebrows.

The installation, in a small apartment built as an addition to a farm house near Troy, N. Y., won Second Prize in the Eastern New York Section's contest for My Most Interesting Lighting Job — the entry of Harry E. Rodman, Professor of Architecture, Rensselaer Polytechnic Institute.

Tesla—
Prophet of Modern Lighting

By DR. S. G. HIBBEN

DURING this year the electrical fraternity is honoring the 100th anniversary of one of its greatest inventors, pioneers and prophets, Nikola Tesla. Some seventy years have been required to realize, in perspective, how much we owe this prodigal genius for his basic discoveries leading to modern transmission and utilization of power, including, with emphasis, the production of light.

An appreciation of Tesla is long over-due! But because he was a modest retiring bachelor, with no organized interest in publicity or appetite for praise, and because many of his studies and dreams were too far ahead of his time to be understood or commercialized, he has to a strange degree remained the unknown pioneer. Tesla deserves great honor for his work with alternating currents, especially of higher frequencies and voltages, and for unique beginnings in the fields of what today we term electronic or wireless transmission, radio, gaseous conductor lamps, fluorescence and ionization, and the modern fluorescent lamp.

Tall, gaunt, Jugoslav-born immigrant, brilliantly developing after a thorough education in Gratz, Vienna, Budapest, and Paris, Tesla came to New York in 1885 to join Thomas Edison in improving direct current machinery. This he emphatically did. But Tesla envisioned the far-reaching power potentials of alternating current so, leaving Edison, he rapidly patented the fundamentals of the rotating electric fields, the split-phase and polyphase induction motor, the methods of transmitting power to long distances and such related discoveries as, for instance, made the hydro-electric plants at Niagara Falls practical.

Where Edison produced an incandescent lamp, Tesla gave the industry the practical method of bringing power to burn it. When Westinghouse pioneered with alternating current generators at the Chicago Worlds Fair in 1893 and Niagara Falls in 1895, it was through the use of Tesla's rotating field patents of 1888 and of his voltage transformers that the electric power era really dawned. After Maxwell and Hertz presented the electromagnetic theory of light, and demonstrated the vast gamut of wavelengths, Tesla some fifteen years later, and onward for half a century, showed how to produce and apply ultra high frequency energy to signaling, guided rockets, therapeutics and long-distance communication.

When electrostatic and spark-gap phenomena were demonstrated in his Greenwich Village laboratory or at famous lectures before the A.I.E.E. and at noted universities here and in Europe, Tesla dreamed of world-wide radio, and with dramatic experiments he unraveled many mysteries of lightning, static charges and high frequency tuned circuits. The useful "Tesla Coil" is a well-known product of his originality. He had a solar heat furnace before Abbott, and his induction heating ideas were a half-century ahead of yesterday's practices. Synchronous motors and the electric clock are but two of his contributions to today's better living.

But when we follow his studies — and working experiments — of phosphors and of fluorescent materials and of discharges in low pressure gases (he gave explanations of molecular and atomic phenomena and remote control or guided missiles, etc., years ago), the wonder is why today's fluorescent, sodium, and mercury lamps were so slow to hatch into commercial illuminants!

Through the kaleidoscopic years of the early part of this century, Tesla, oblivious to fame and money, was truly prodigal in demonstrating — then, too often dropping — idea after idea, including light sources operating without filaments. He showed the methods of getting light from neon, carbon dioxide and mercury vapors, and though he lacked today's electronic oscillator or magnetron tubes, yet with pressures on the order of 100,000 to 4,000,000 volts and frequencies beyond 200,000 cycles, often from resonant circuits and capacitor discharges through spark-gaps, he led far along the road that we are traveling today.

For instance, he predicted and demonstrated wireless power for generating "cold" light, and such devices as the electroluminescent plates—still to be perfected today.

If all other basic contributions of Tesla be omitted, he should be famous for the standardization of 60-cycle power; for proving that the incandescent method of generating light was but a first step toward the future better methods; and for demonstrating how high frequency electric excitation of atoms can result in creating higher frequency oscillations, or radiant energies called "light."

Nikola Tesla has for much too long been the lighting fraternity's "forgotten man." It is appropriate that he be now honored.

AUTHOR: Chairman, Historical Committee, I.E.S.

LIGHTING NEWS

Boston—September 17-21, 1956

I. E. S. Fiftieth Anniversary Conference

Very special circumstances surrounded the 1956 National Technical Conference. In addition to its regular Conference features, it celebrated, nationally, the Golden Anniversary of the Illuminating Engineering Society. Its very location, Boston, Massachusetts, was part of this; the Society's first convention was also held in Boston. And the New England Section was the Society's first local "branch."

That there was something *quite special* about this I.E.S. Conference was evident before arrivals even reached the hotel entrance. In Boston's Park Square, immediately in front of the Statler, there towered a golden pylon glowing with light. Its fifty illuminated gold panels symbolized the significance of the Golden Anniversary of the Illuminating Engineering Society and its progress through the years. Pointing upward as it did, the sculpture, which did not taper or step back at the top, further signified no diminution of achievement, yesterday, today or tomorrow. Its symbolism of progress spiralling upwards through the years, was as inspiring as it was beautiful. Its form also denoted in sculpture that lighting's progress has not been a smoothly flowing line; rather it has been irregular, violent, dynamic. With the introduction of each major light source, have come developments which completely changed our ways of thinking. The illuminated sculptured form represented this ever-changing pattern, with its complete absence of smoothly flowing lines and its bold thrusts in new directions. So, to delegates at the Conference throughout the week and to all passersby, the glowing, golden sculptured form in Park Square had a strange, significant beauty.

The Golden Pylon was the design of M. Henry Kruger, Chairman of the Lighting and Decorations Committee, and was constructed as a tribute to I.E.S. from fourteen firms. (See list at end of this report). Light from its fifty lamps was turned on by President Hartenstein in a special ceremony widely covered by press, radio and television.

Boston itself entered into the Society's celebration of its Fiftieth year. Ever since last Spring, strollers in famed Boston Public Gardens viewed with pleasure, a beautiful planting in colored shrubs spelling out a commendation and welcome to I.E.S. on its Fiftieth anniversary. This huge, lovely planting was one of the most photographed spots in Boston, by every I.E.S. delegate who had a camera.

Another civic participation in the anni-

Conference Statistics

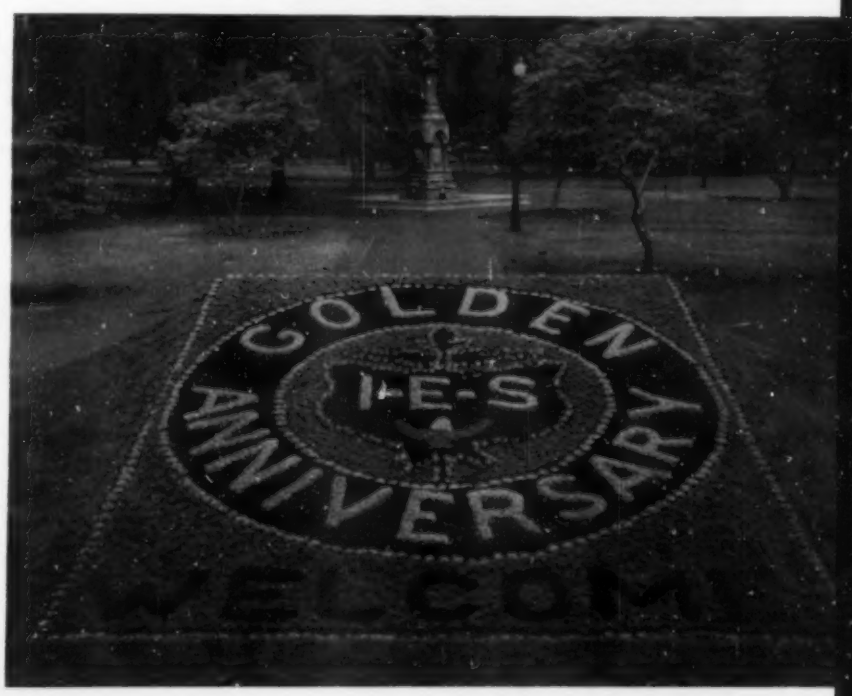
Attendance:

Delegates	696
Ladies	264
	960

Place: Hotel Statler, Boston, Mass.

Date: September 17-21, 1956

IN Boston's Public Gardens, the City of Boston planted this huge colorful welcome for the I.E.S. Golden Anniversary. Authorization for this summer-long display came from the mayor of Boston, at the request of the Boston Edison Co.

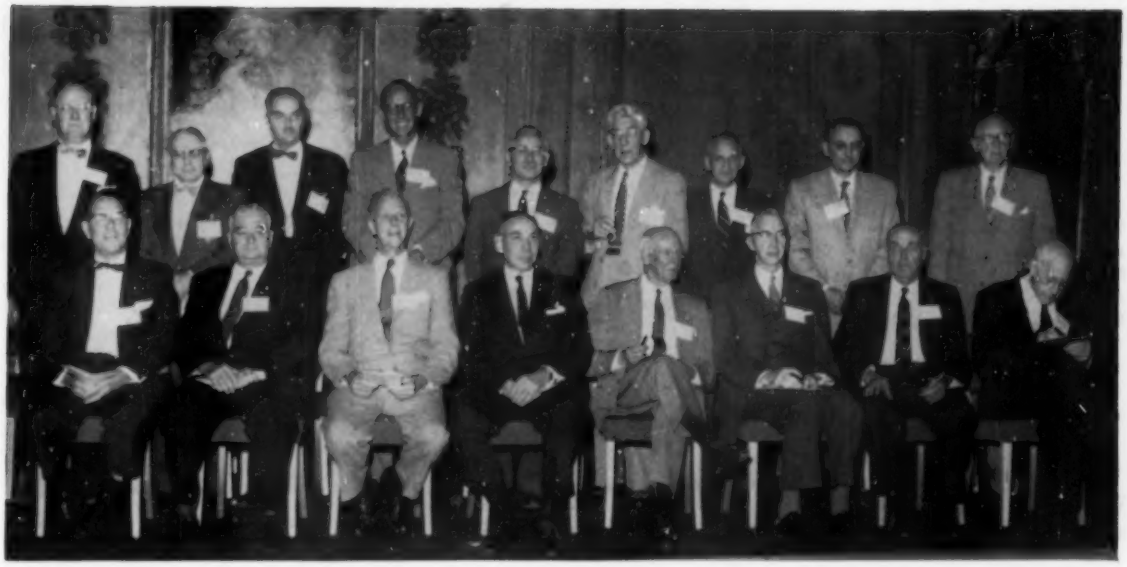


SYMBOLIZING fifty years of lighting progress — 37-foot pylon erected in Boston Square (left). Fifty golden elements, each glowing with light, spiralled upward denoting that light's progress has been continuous, dynamic. The Golden Pylon was the design of M. Henry Kruger, Smithcraft Lighting Co., and was constructed as a tribute to I.E.S. from fourteen Sustaining Members. Turning on the Pylon (right) in civic ceremony Sunday, September 16 — I.E.S. President R. F. Hartenstein. Looking on, left to right are M. N. Waterman, incoming President, Henry Kruger, Julius Daniels, past-president, and R. B. Brown, Jr., Chairman of the Anniversary Conference.

Some Golden Anniversary Events

PAUL REVERE'S lantern, held by R. B. Brown, Jr., is shown in comparison with Edison's first carbon filament lamp (center, held by R. F. Hartenstein), and a reflector mercury lamp (right), shown by M. N. Waterman.

AULD LANG SYNE. A never-to-be-forgotten moment at the 1956 Banquet. The entire assembly joined hands to sing a tribute to days gone by. Shown here is part of the head table.



CONVOCATION program at Fiftieth Anniversary Conference honored Past Presidents of I.E.S. Former leaders of I.E.S. present at this colorful ceremony are: seated, left to right — G. K. Hardacre, A. F. Wakefield, W. C. Brown, Julius Daniels, W. F. Little, H. H. Magdsick, Ward Harrison, George S. Crampton. Standing, l. to r., R. F. Hartenstein, R. B. Brown, Jr., Duncan Jones, A. H. Manwaring, E. M. Strong, S. G. Hibben, Walter Sturrock, C. H. Goddard, L. E. Tayler.

versary involved Paul Revere's lantern. This famous lighting device, used to signal the coming of the British in the American Revolution, was removed from the steeple of Old North Church to be shown with Thomas A. Edison's first carbon filament lamp, and a typical present-day light source.

Golden Anniversary Convocation

Culmination of the Society's year-long celebration of its anniversary was, quite appropriately, several special commemorative features at the National Technical Conference. Highlight of the celebration plans was the Convocation Session held on Tuesday afternoon, September 18, " . . . convened to note the status of illuminating engineering in this the Society's fiftieth year, and to recognize those leaders who have provided the basis for human advancement through better lighting." A number of great leaders were so recognized.

Dr. Langmuir, Honorary Member of I.E.S.

Dr. Irving Langmuir, Nobel prize-winner and famed research scientist was made an Honorary Member of I.E.S., in recognition of his historic service to lighting in developing the gas-filled incandescent electric lamp. His new lamp replaced the costlier vacuum lamp and constituted an important step in improved health and reduced living costs of every contemporary American family.

Robert F. Hartenstein, President of I.E.S. made the award during the convocation ceremony. Willard C. Brown, manager of Application Engineering Division, General Electric Company, Cleveland, Ohio accepted the scroll of membership for Dr. Langmuir and addressed the session in his behalf. Subsequently, the beautifully illuminated scroll was presented to Dr. Langmuir at Schenectady by Willard Brown, R. F. Hartenstein and Henry L. Logan, Chairman of the Task Committee on Honorary Membership. Dr. Langmuir retired in 1950 after 40 years of service at the General Electric Research Laboratories, Schenectady, N. Y.

Dr. Langmuir is only the fifth person to be made an Honorary Member of I.E.S. Thomas A. Edison was the first Honorary Member, being elected in 1916 on the Society's tenth anniversary. The other three were Edward L. Nichols, 1921, a pioneer in light measurement, and Andre Blondel and Elihu Thomson, both at the 25th Anniversary conference in 1931. Blondel made major improvements in arc lights and Thomson developed the use of quartz in electric light bulbs.

Dr. George S. Crampton Gold Medal Award

The I.E.S. Gold Medal, highest award of the Society, was presented to Dr. George S. Crampton, Philadelphia ophthalmologist, teacher and inventor of many unique optical devices. President Hartenstein made the presentation.

In accepting his award, Dr. Crampton paid tribute to the illuminating engineers for their constant efforts to improve street and highway lighting and to develop auto headlights in an effort to check the nation's rising traffic casualty lists.

Dr. Ward Harrison, a past-president of I.E.S. introduced Dr. Crampton, expressing the Society's gratitude for the "fresh viewpoint of an ophthalmologist with a keen interest in the relation of light to sight."

Dr. Crampton, who is 82, is also a past-president of I.E.S. (1921-1922), and has a long record of valuable service to illuminating engineering and its professional society. Still an active member of the Philadelphia Section, he has served with numerous I.E.S. committees throughout the years.

Past-Presidents Procession

Seventeen Presidents of I.E.S. were honored on the occasion of the Fiftieth Anniversary Conference. Throughout the Convocation Session they were seated in a place of honor, on a specially-constructed platform facing the audience. Presidents attending this special program were:

George S. Crampton, 1921-1922
Ward Harrison, 1922-1923
H. H. Magdsick, 1929-1930
W. F. Little, 1930-1931
Julius Daniels, 1931-1932
Willard C. Brown, 1941-1942
Richard B. Brown, Jr., 1942-1943
A. F. Wakefield, 1945-1946
G. K. Hardacre, 1946-1947

L. E. Tayler, 1948-1949
C. H. Goddard, 1949-1950
Walter Sturrock, 1950-1951
S. G. Hibben, 1951-1952
E. M. Strong, 1952-1953
A. H. Manwaring, 1953-1954
D. M. Jones, 1954-1955
R. F. Hartenstein, 1955-1956

Eight other living Presidents of I.E.S. who were unable to attend the ceremony were also honored at the Convocation Session. These are: Edward P. Hyde (1910); V. R. Lansingh (1912); G. H. Stickney (1917-1918); Matthew Luckiesh (1925-1926); J. W. Barker (1932-1933); J. L. Stair (1933-1934); L. H. Graves (1939-1940); Howard M. Sharp (1943-1944); S. B. Williams (1944-1945).

Procession of Fellows

Also seated in places of honor at this historic session were 56 of the Society's Fellows. These 54 men and two women represented all of the Society's 99 Fellows, outstanding members of I.E.S., specially elected to this highest Grade in recognition of their achievements in illuminating engineering.

Leaders in Other Professions

To further mark the fiftieth anniversary, a special Task Committee had earlier this year studied the work of several men in professions other than illuminating engineering, but whose achievements had nevertheless been of great benefit to the aims of I.E.S. Five such men were chosen for special recognition on the occasion of the Convocation. These five men. . . " . . . whose work has been independent of the Illuminating Engineering Society yet who by such work has materially facilitated the advancement of the objectives of the Society . . . " were presented framed, beautifully-wrought illuminated certificates of appreciation. Chosen as recipients of this honor were: Mason Bigelow, Ned H. Dearborn, Eero Saarinen, David Sarnoff, George Wald.

I.E.S. Gold Medal, highest award in illumination is presented to Dr. George S. Crampton, right, by President Hartenstein.

Convocation Papers Session

A group of three invited speakers presented papers before this session . . . "to note the status of illuminating engineering in this fiftieth year . . . " Marshall N. Waterman, President-Elect was chair-

(Continued on page 13A)

FIFTY-SIX of the Society's Fellows, highest grade of membership, were also honored at the Convocation Program, commemorating the fiftieth year of I.E.S.

Kopp

FLYING GLASSWARE

meets *Exacting* specifications

In our own shop, dies and moulds are made, from Kopp engineering designs.

Airport runway lens of extremely complex design being tested for distribution and intensity of illumination.

The utmost dependability under extremely severe service conditions is a requirement of glassware for aircraft applications. Extensive experience in the design and manufacture of specialized glassware has enabled Kopp to develop many special designs that have proved more than a match for the exacting demands of aircraft service.

If you're confronted with a vexing industrial glass problem, let our engineering department help you find the most practical and economical solution.

SUSTAINING MEMBER

KOPP GLASS

KOPP GLASS, Inc.

Swissvale, Pennsylvania

American Metal Products Company, Detroit, Michigan

Quality high bay lighting at low cost...with ABOLITE

At a minimum of cost, a new high in quality high bay mercury lighting is reached in this installation of ABOLITE 24" diameter aluminum Uplight Mercury Units, using General Electric H 400-RC1 color improved mercury lamps.

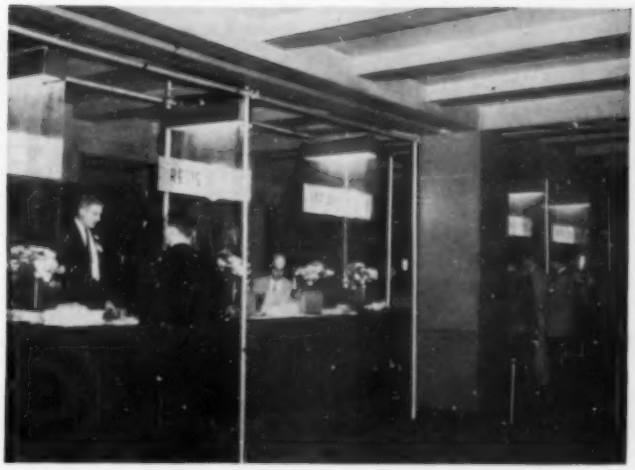
An 18% upward light component washes out ceiling contrasts and provides outstanding overall illumination. Good shielding also contributes to maximum visual comfort.

Maintenance costs are greatly reduced due to ventilation of the lamp and fixture resulting from the open top design of the ABOLITE Uplight Mercury Unit. In addition, costs are further reduced because of the inherent low price of mercury lighting.

Compare the quality and economy of this ABOLITE installation with quality fluorescent lighting. Be sure you have the latest information on these new ABOLITE Uplight Mercury Units. Write today.

General Contractor: The Austin Company
Electrical Contractor: Hall Engineering Company
Electrical Distributor: General Electric Supply Company
Installation Data: ceiling height is 35', mounting height is 28' and spacing is on 20 foot centers. 35 foot-candles average initially.

ABOLITE *Lighting* DIVISION
THE JONES METAL PRODUCTS CO
WEST LAFAYETTE, OHIO



REGISTRATION DESK — as befits a society of illuminating engineers, lighting design was used to provide high levels of illumination and attractive surroundings. "Information," "Transportation," and other such departments were identified in light and plastic.

AS THE OFFICERS appeared at the first convention — so did President Hartenstein, left, and General Secretary George J. Taylor, at the Fiftieth Anniversary Conference. Formal morning attire was worn for their conference addresses at the opening session.

(*Continued from page* 10A)

man of the session. Three outstanding lectures presented were:

"Atomic Power for Tomorrow's Lighting" — A Key to Better Seeing — by William Webster, Executive Vice-President, New England Electric System.

"Visual Reception" — How We See — by Dr. Brian O'Brien, Director of Research, American Optical Company.

"The Assessment of Brightness" — What We See — by Dr. R. G. Hopkinson, Department of Scientific and Industrial Research, Garston, England.

Present in the audience were, of course, the special "Anniversary Representatives" from the Sections and Chapters, each of them identified by a gold carnation.

Convention Events

To do justice to a report on the Conference itself, one must start with the Registration Desk — because the care, thought and ingenuity which went into its construction was indicative of the same "engineered" thoughtfulness which contributed to the success of the whole meeting. Referring to the photograph of it, though none too clear, one gets some idea of its clever arrangement. "Information," "Registration," "Transportation" and all such were departmentalized and identified with a very ingenious use of light and plastic. While there may not yet be a Recommended Practice for Lighting to Register I.E.S. Members, the registration desk at Boston must surely serve as an advance example. Description of the installation, construction details, footcandle levels and brightness ratios were not supplied by the committee; one may take the word of all delegates to the convention that its success lay in the convenience and comfort of its lighting design.

Officers Report

Suggestions of the anniversary theme crept into many an event throughout the week. At the opening session, devoted to a report from the officers, President Hartenstein and General Secretary George Taylor turned up in impeccable morning dress, complete with tails and ascot tie, as a reminder that thus did the officers appear at the first I.E.S. convention. Their reports, however, were definitely 1956. Complete text of President Hartenstein's address, and of President-Elect Waterman's have been published in the September issue of I.E.

The General Secretary's Report, by George Taylor, defies description. The accompanying photograph of his final display would need to be in color to be appreciated, and the report itself would have to be seen and heard for its full impact.

(*Continued on page* 14A)

GRAPHIC display, in black light, of the General Secretary's Report. George Taylor's mammoth charts illustrating his report to the membership astounded and delighted the opening session audience.

NINE new Fellows of I.E.S. received the coveted white lapel pin denoting their election to this highest grade. Seated, l. to r.: Bruce Jensen, Dorothy Nickerson, Gwilym Prideaux, C. K. Hardacre, Eric H. Church. Standing, l. to r., Charles Laupp, M. N. Waterman, G. F. Dean, George A. Horton.

(*Continued from page* 13A)

Disposition of Society funds was demonstrated via an illuminated plastic sphere (center in the picture) divided to show this year's expenditures and where they were expended. Huge, six-foot (plywood) charts were carried on during the progress of Mr. Taylor's Report, to demonstrate graphically the details of his address. Section/Chapter growth from 1906 was shown in decades by ever-increasing bars, as was membership, and sustaining membership. Changes in the Society's journal and expansion of its influence was shown with actual covers of the magazine, and bars giving its increasing circulation over the years in thousands. The work of the technical committees of I.E.S. was highlighted in another huge chart. Statistics on technical sessions presented by local and national I.E.S. meetings, and the number of papers given, was the subject of still another chart. All this was illuminated from concealed lamps in specially-constructed stands.

At the conclusion of Mr. Taylor's report, these lights were turned off, and simultaneously ultraviolet units turned on — to disclose in a breathtaking display that all elements of the charts were in phosphorescent materials, glowing with many different colors in the black light. The entire display was an astounding experience; never, it was felt, had the Society's fiscal and membership affairs been received with such rapt, pleased attention.

The Opening Session audience also witnessed two interesting presentations both made by President Hartenstein. A newly-designed Past-President's Pin was given to past-presidents of I.E.S., replacing the rather large previous design. The new pin quickly identifies its wearer as a past president of the Society by a small diamond mounted in the emblem design.

Nine of ten newly-elected Fellows of the Society (see September I.E., p. 9A) also participated in a ceremony in which they were presented with their white lapel pins denoting Fellow Grade. The pin will be mailed to the remaining new Fellow, Earl A. Anderson, who was unable to be present.

MMILJ Contest

Installation details on the "most interesting jobs" of three of the happy winners of the national MMILJ Contest are shown in this issue of I.E. (See p. 714.) There were ten entries, one from each Region. The judges admittedly had a rough time. The full-house audience envied them not, so almost indistinguishable was the excellence of one job from another. Judges were: Messrs. E. W. Commery, C. L. Crouch, R. F. Hartenstein, S. G. Hibben, M. N. Waterman. Their judgment:

First Prize: B. F. Jones, South Pacific Coast Region.

Second Prize: Miss Dorothy McGregor, Pacific Northwest Region.

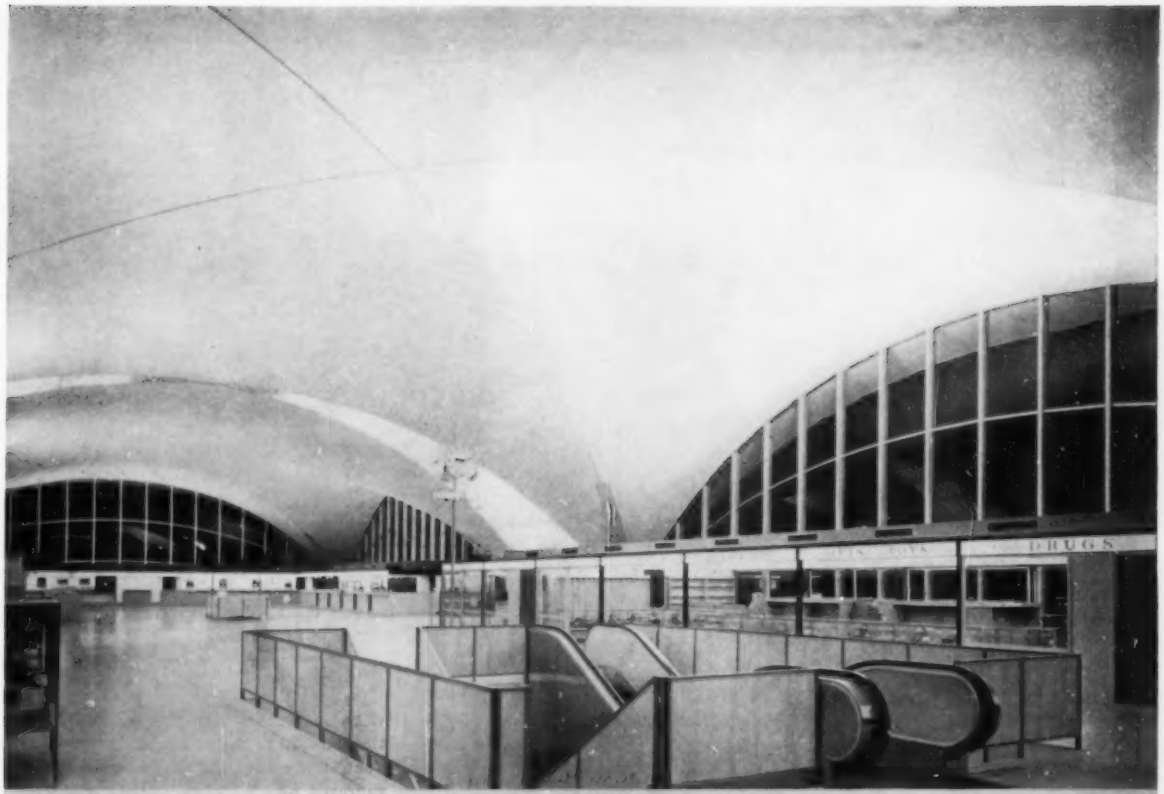
Third Prize: E. H. Schaefer, Midwestern Region.

Fourth Prize: L. N. Goodman, Southern Region.

Runners-up, all of whose outstanding installations will subsequently be published in I.E. are:
R. S. Tate, Canadian Region.

(*Continued on page* 16A)

MMILJ Contest. Their jobs were tops in Section and Region. National competition, one from each of the ten I.E.S. Regions were: front row, l. to r. Dorothy McGregor, H. Seiter, Ruth Patterson, R. C. Tate, Elizabeth Meehan, Louis N. Goodman. Back row: Harold Friedman, B. F. Jones, Edward Schaefer, and J. D. Whitnell (Proxy for C. D. Bell).



St. Louis Municipal Airport Terminal Building

•

Hellmuth, Yamasaki & Leinweber, Architects
Ferris & Hamig, Electrical Engineers
Roberts & Schaefer, Dome Consultants

•

• 110KW in color corrected mercury lamps, neatly concealed, produce this masterpiece of comfortable indirect light. Not an installation in America like it!...There are 100 Rambusch Field Representatives. One of them is near you and anxious to serve.

RAMBUSCH **DESIGNERS • MANUFACTURERS**
40 WEST 13th STREET, NEW YORK 11, N. Y.

THE WINNERS! Congratulating each other are the four top winners in the MMILJ contest. In the order of their prizes are: B. F. Jones, South Pacific Coast Region; Dorothy McGregor, Pacific Northwest Region; Edward Schaefer, Midwest Region; Louis N. Goodman, Southern Region.

B. F. JONES, first prize winner in the national contest for My Most Interesting Lighting Job, receives certificate and check from President Hartenstein, and the applause of the entire conference.

(Continued from page 14A)

Miss Elizabeth Meehan, East Central Region.

G. H. Seiter, Great Lakes Region.

C. D. Bell, Inter-Mountain Region.

Miss Ruth Patterson, Southwestern Region.

Harold Friendman, Northwestern Region.

Lee E. Tayler, Chairman of the Lighting Service Committee under whose sponsorship the contest is conducted, presided at the national contest. Winners were announced and prizes presented during the banquet Thursday evening.

An innovation this year is the additional award to the winner of the MMILJ Contest of a beautiful silver trophy, to be engraved with his name, Section and Region. This permanent trophy is a gift to the Society from Charles H. Goddard, a Past-President of I.E.S. (Further details of the Goddard Trophy are published on page 713 of this issue of I.E.)

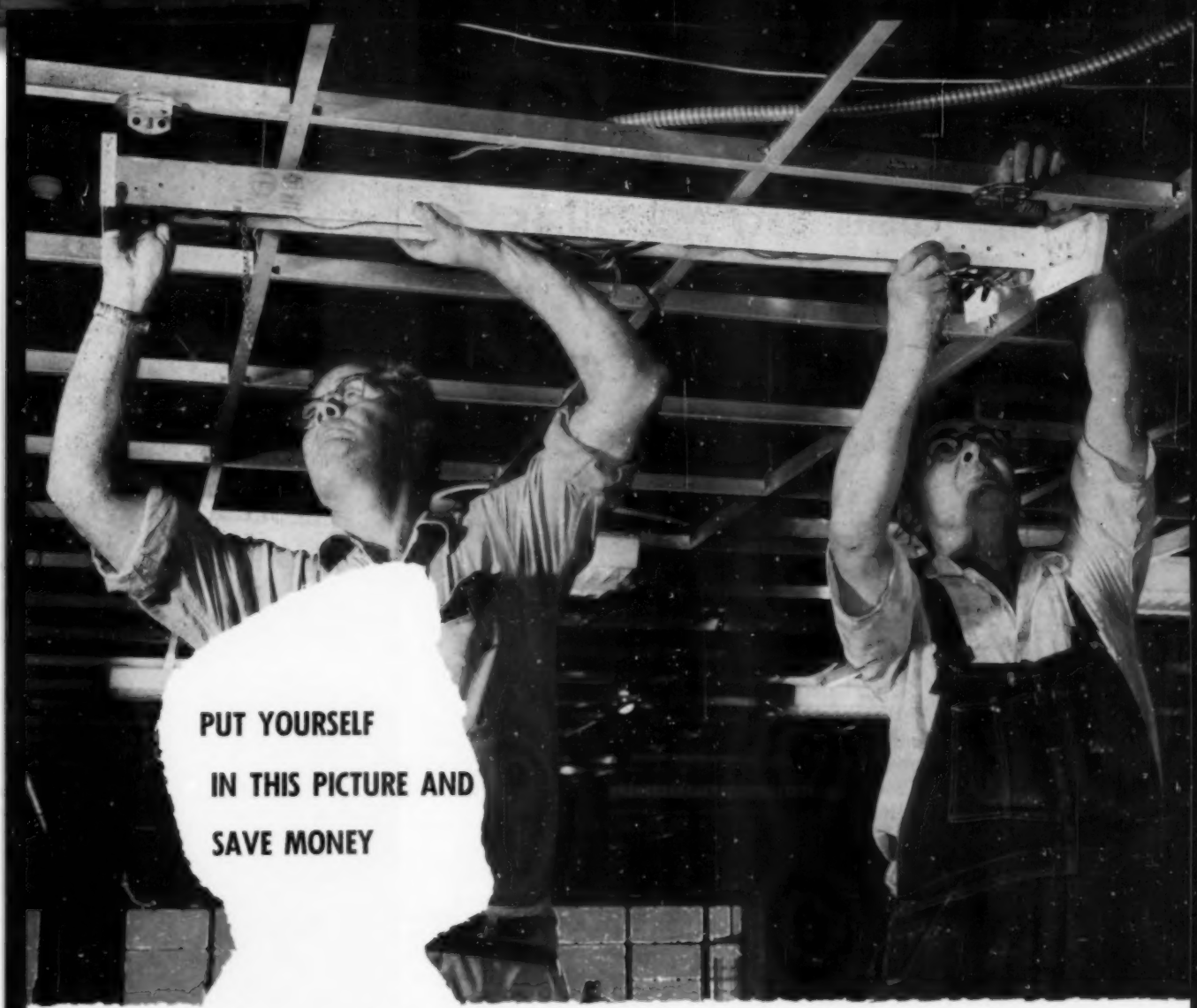
ALLIED ARTS Exhibition. Panel of prominent Boston architects and engineers reviewed architectural drawings and their lighting designs entered by student architects and engineers in this interesting I.E.S. program. Review Board, l. to r. Curtis Foster, Leslie Ford, Willard Thompson, Isadore Richmond, Richard D. Kimball. At right is Karl Staley, General Electric Co., Chairman of the I.E.S. Committee on Allied Arts.

Allied Arts Exhibition

Another interesting item on the Wednesday Morning Session was the presentation of Letters of Commendation to student exhibitors of architectural drawings. Karl A. Staley, Chairman of the committee sponsoring this program made the presentation. Top two ratings in these exhibits went to Delmer Beckhard of the University of Southern California, and a team of students from Kent University and Akron University. These students were Donald Nupp, Ray Eads, Ray Lynn and Charles Dunn.

A panel of prominent Boston architects and engineers had reviewed the exhibits of a number of student architects participating in the Allied Arts program, which is sponsored each year by I.E.S. to attract students to the lighting profession. Board of Review this year was: Willard Thompson of Thompson Engineering Company; Richard D. Kimball, consultant; Isadore Richmond of Goldberg and Richmond, architects; Leslie Ford and Curtis Foster, of the Charles T. Main Company, all of Boston.

(Continued on page 21A)



Flower Street Building, Los Angeles • Zamboni Bros., Electrical Contractors

*patent pending

CONTRACTORS for the lighting installation shown above were astounded to learn that these Sunbeam Visionaires® could be mounted and connected at the rate of about 6 minutes each — resulting in great savings in labor costs.

ARCHITECTS are delighted because for the first time they can plan for "surface" mounted lighting directly on suspended ceiling systems — with fixtures either parallel with or diagonal to the ceiling grid runners.

This new installation device **(CSM7)*** is the product of Sunbeam Lighting design ingenuity — planned with you in mind to increase the flexibility of fine Sunbeam Visionaires® and to help cut installation costs.

No tools are required — the hangers are simply clipped on the runners and remain in position as the fixtures are lifted for attachment. A few twists of the wing nuts hold fixtures in place. Before "cinching up," the fixtures may be slid along the runners to the exact location required. Ask you local Sunbeam lighting representative to demonstrate the new money saving **(CSM7)*** hanger.

SUNBEAM LIGHTING COMPANY

777 East 14th Place, Los Angeles 21, California

Use Sola ballasts in your fixtures and you are assured immediate

"defective-in-warranty" replacement service, anywhere in the U.S.A.

Sola Electric Co. has launched a unique new ballast service plan. It enlists electrical wholesalers throughout the country as Sola Ballast Service Centers, *even though they don't stock Sola ballasts.* Electrical contractors are thus enabled to get an immediate, FREE certified CBM ballast replacement, from their regular local wholesaler, for any defective-in-warranty Sola ballast they bring in.

As an incentive to participate in the plan, qualified electrical wholesalers will be paid by Sola for their cost plus their full profit on the equivalent certified CBM ballast replacement, regardless of brand. Any qualified electrical wholesaler who stocks certified CBM ballasts for over-the-counter sale can participate in the plan. Sola also provides a variety of free promotional aids to wholesalers to advertise the service to their electrical contractor customers.

The quality standard of Sola ballasts

The Sola Ballast Service Plan is made possible because Sola ballasts have an exceptionally low failure ratio. Less than 14/100-of-1% of *all* Sola ballasts fail in-warranty, and less than 9/100-of-1% of Sola Rapid Start ballasts fail in-warranty. This unusually low failure ratio is due to Sola's very high standards of quality in engineering and manufacturing.

Here's how the plan works

1. Should an electrical contractor anywhere in the U.S.A. find a Sola ballast which has failed in-warranty, he returns it to any qualified wholesaler who stocks Sola ballasts, or certified CBM ballasts of *any* make. The wholesaler checks the warranty date stamped on the ballast cover.

UL

CBM CERTIFIED by ETL

2. If the ballast failed within two years of the warranty date, the wholesaler gives the contractor another Sola ballast if he stocks them. If not, he refers to a ballast replacement guide provided by Sola to find an equivalent certified CBM ballast of another make which he stocks.

3. The wholesaler gives the new Sola ballast or the certified CBM ballast replacement to the contractor immediately, without charge. There is no red tape, no delay. The contractor merely signs a receipt and takes the replacement with him.

4. The wholesaler sends the receipt with his invoice to Sola Electric Co. Within 30 days, Sola sends him a check for his wholesale cost of the replacement ballast plus his usual profit on it, just as if he had *sold* it to the contractor.

Write for complete information

Most lighting fixture manufacturers are already familiar with the high quality and dependability of Sola fluorescent ballasts. This new Sola Ballast Service Plan is another tangible advantage which makes Sola ballasts your best choice for installation in your fixtures. You are assured that the ultimate user of your fixtures, regardless of location, will get quick ballast replacement service to restore his fixture to perfect operating order should a Sola ballast fail.

If you would like more information about this unique plan, write or call Sola Electric Co. If you wish, a sales engineer will call on you to give you any other information you may want to know about Sola ballasts or other products.

Sola has complete warehouse stocks on both coasts and in the Midwest for prompt shipment, and is represented by qualified sales engineers with offices in every principal marketing center in the U.S.A. In addition, a large number of qualified wholesalers in principal cities stock Sola ballasts. Now, Sola offers comprehensive in-warranty service coverage through thousands of other qualified wholesalers who stock certified CBM ballasts of other makes. Mail the coupon for complete information.

SOLA
Electric Co.
4633 W. 16th St.
Chicago 50, Ill.
Bishop 2-1414

TO: SOLA ELECTRIC CO.
4633 West 16th St., Chicago 50, Ill.

☐ Please mail a detailed explanation of the Sola Ballast Service Plan.
☐ Please have a Sola sales engineer call.

My name_____

My title_____

Company_____

Address_____

City_____ Zone____ State_____

GARCY

5600 Series Recessed Luminaire

with one-piece plastic shield

Weigh it

against other Large-Area Luminaires

Compare this plastic panel with the shielding on other 4 ft. by 4 ft. fixtures. Where the conventional flat panel sags of its own weight, Garcy's die-formed contour gives lasting stability...permits lighter weight and reduced ceiling load. Installation, cleaning and relamping go more quickly. The panel swings down easily in its hinged frame, puts no strain on the fixture or the worker.

Compare it also for beauty, durability, efficiency. When the fixture is lighted, the contour is hardly noticeable, lending an unobtrusive but interesting "character" to the ceiling treatment. The light is evenly diffused and efficiently transmitted. For the luxury look in lighting, choose Garcy's 5600 Series.

Available in the following sizes: 4′ x 4′; 2′ x 2′; 2′ x 4′; 2′ x 8′. Also available with Alba-Lite glass or louver shields.

Send for Bulletin 552-L

GARCY **Quality by *Design***

Garden City Plating & Mfg. Co., 1760 N. Ashland Ave., Chicago 22, Illinois

In Canada: Garcy Co. of Canada, Ltd., 1244 Dufferin Street, Toronto 4

PAST-PRESIDENT'S Pin is placed on the lapel of outgoing president R. F. Hartenstein by the 1956-1957 President Marshall N. Waterman.

NEW ENGLAND Section's gift to President and Mrs. Hartenstein, a beautifully-wrought Revere silver bowl, is presented by W. B. Elmer (center), Section Chairman.

(*Continued from page* 16A)

Progress Report

The Progress Report always makes history. Certainly this year's did. Narrator for the parade of lighting progress was the Progress Committee Chairman, J. H. McCulloch. His dramatic presentation outlined the progress during the past year at home and abroad — in equipments, in light sources, in techniques. Part I of this program was a lively presentation, with colored slides, of new developments. Part II was a "Lightorama" of individual stages on all sides of the ballroom, manned by members of the Progress Committee. Each booth displayed actual equipments or techniques demonstrating developments in a particular field of illumination.

As usual, latecomers had to stand. To afford an opportunity for all who wish to see this entertainment-coated educational program to attend, the session was held in the evening, September 18. Wives, visitors and conference delegates packed the huge room.

Social Program

Highlight of the Convention social program is usually the banquet. It was this year too, though it had stern competition with a number of other items offered by the Entertainment Committee. Monday night's fun, as an example. This was a Cavalcade of Dances with six Arthur Murray dance instructors, plus plenty of audience participation. Dance steps from 1906 to 1956 were demonstrated by these skillful professional dancers — the Cake Walk, the Castle Walk, the Charleston (here a dead giveaway of thunderous applause from the I.E.S.ers), Lindy Hop, etc. etc. The audience joined in a Conga line and later danced till midnight.

One very memorable scene at the Monday night dance was an exhibition waltz by Mr. and Mrs. Leo Dolkart. Mr. Dolkart, a member from Chicago, is one of the few living Charter members of I.E.S., and the only one present at the Fiftieth Anniversary Conference. During the waltz, pretty girls cut in on Mr. Dolkart, and handsome young dance instructors danced with Mrs. Dolkart.

The Clam Bake Wednesday night could also vie as a top highlight. This was held at Plymouth, Mass., right on the shore, some 40 miles from Boston. In the authentic tradition of New England clam

(*Continued on page* 22A)

PROGRESS Report, ever a highlight of the national conference. Shown at one of the individual stage sets for 1955 lighting developments are J. M. McCulloch, Chairman of the Progress Committee, Frank Marriett, Chairman of the Residence Lighting Committee, and Miss Emily Alexander, Georgia Power Co.

OFFICERS of I.E.S. and their wives grace the head table at the Anniversary Banquet. Souvenir menus featured a color photograph of the I.E.S.-Welcome planting in Boston Public Gardens. Past-Presidents and their wives are seated to the left, directly in front of the stage.

(*Continued from page* 21A)

bakes, the food was steamed all together over hot stones, a huge steaming pyre of clams, fish, sweet potatoes and lobster. Some 900 people attended this shore picnic. All were served quickly at long church supper style tables.

On Thursday night there was, of course, the brilliant Anniversary Ball. For the last day of summer, white dinner jackets prevailed highlighting the color of the ladies' formal gowns. Small souvenir bean pots were at each place, with decals commemorating the date, the place and the occasion. The dessert at the banquet was also part of the 50-year celebration. Golden, illuminated globes (of ice cream) were carried in a colorful procession by a long parade of waiters.

Ooo-oo! Look! Anniversary dessert at the Banquet. Illuminated golden globes (of ice cream) paraded into the darkened banquet hall.

Ladies Program

The program enjoyed by the 264 ladies present at the Conference can only be described as a "social whirl." A two-weeks vacation rolled into one. Two-hundred and sixty-four I.E.S. members will have no peace next year, till their wives can have another opportunity for a week as enjoyable as this.

It even started before the Conference began. On the Sunday evening as delegates checked in, there was an Early Bird Social. Snacks after the long drive, train or plane. Greetings from old friends, meetings with new ones. A spectacular color film of New England's coast line, narrated by the "flying Santa Claus," Edward Rowe Snow.

It all got going again Monday morning, with a Get Acquainted Brunch (a daily affair thereafter), in the ladies' own hospitality suite. The brunch was followed by a talk "Fun with Food" by a representative of the S. S. Pierce Company, famous New England food purveyor. Right after lunch on Monday, they all went on a trip to the Saugus Iron Works. The ancient Works, and the cen-

(*Continued on page* 24A)

extra large extrusions

KSH

extra complex extrusions

doing the "impossible" in plastics

Turning problem shapes into consistently uniform extrusions is a unique talent that has built KSH an industry-wide reputation for doing the "near impossible" in plastics! No challenge is considered too big or too tough. Remember, come to KSH for higher quality at a competitive price.

KSH PLASTICS...YOU DESIGN THE SHAPE...WE EXTRUDE IT

KSH

SALES OFFICES

KSH PLASTICS, INC. • HIGH RIDGE, MO.
Chicago, Ill. • Milwaukee, Wis. • Indianapolis, Ind.
Dayton, Ohio • Atlanta, Ga. • Grand Rapids, Mich.
St. Louis, Mo. • Ped Bank, N. J. • Boston, Mass.

TRAVEL Gavel — won again by New Orleans Section. J. M. Gensburger, the Section's 1955-1956 Chairman accepts the silver-mounted gavel and anvil from President Hartenstein. This award goes annually to the Section or Chapter having the largest attendance at the conference, in percentage of the Section membership, and miles traveled to the conference.

(Continued from page 22A)

turies-old homes nearby have all been restored and are seen now as the Pilgrims knew them. Monday evening, of course, everybody went to the Cavalcade of Dances in the ballroom of the hotel.

On Tuesday morning (after coffee in the ladies' suite) quite a few feminine visitors took in one of the technical sessions of the conference. The Residence Lighting Forum Session had three speakers, each presenting papers of particular interest to women as well as lighting specialists and their audience was packed with visiting ladies. Emily Alexander of the Georgia Power Co. spoke on "Planning Lighting with the Home Owner"; Nelson J. Bleisch of the Union Electric Company, St. Louis, covered "Light for Living Indoors and Out"; and Ruth Patterson of the Dallas Power and Light Co. spoke on "Designed Lighting for Texas Homes," all beautifully illustrated.

Tuesday was a full day, as a matter of fact. After lunch and a tour of the Gardner Museum, the entire group of visiting ladies were invited to tea at the home of Mrs. Hugh Nazor, Ladies' Committee Chairman, in suburban Belmont. This was definitely one of the highlights of the week. Tuesday evening was filled too; both men and women attended the Progress Report at 8:30.

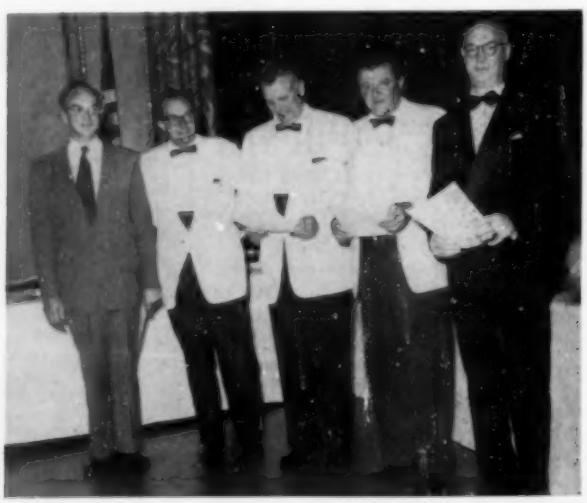
Wednesday, of course, had the Clam Bake, already described. Quite a few of the Conferees took advantage of a planned sight-seeing trip prior to this though, which ended up at Plymouth and the clam bake. Chartered buses toured historic spots; a tourists dividend was the brilliant autumn foliage of New England's countryside.

The Ladies' Committee had purposely left Thursday free, in view of the Anniversary Ball that evening. The hotel beauty parlor had a busy morning, but hostesses were still on hand to help plan trips, shopping excursions, or card games.

All of these events were kept track of in special little note cases, purse-size, which were given to each lady with her conference envelope. The case held note paper, calendar, and a specially printed-to-size book listing time and place for every item on the ladies' program.

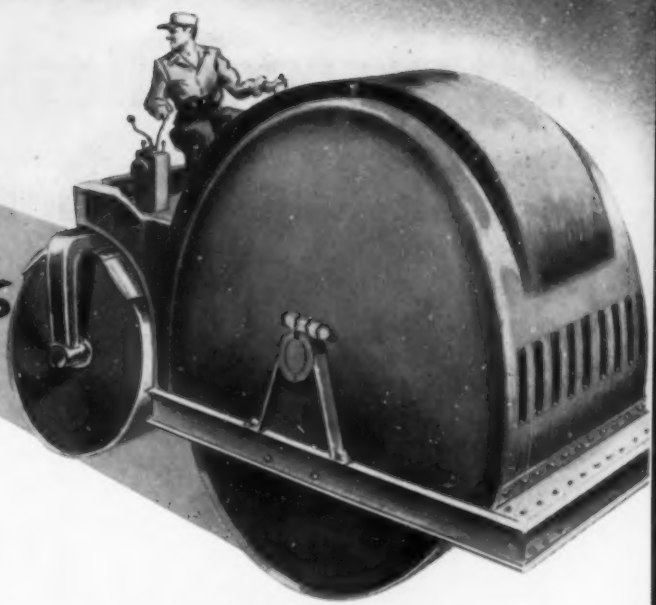
(Continued on page 27A)

CHARTER Member Leo Dolkart, right, with President Hartenstein at the 1956 Conference. Charter members of I.E.S. are members joining the Society before February 13, 1906.



MEMBERS of Council whose term expires following this conference received certificates of appreciation during the banquet. Left to right are: Dan Finch, South Pacific Coast Regional V-P; James R. Chambers, Midwestern Regional V-P; A. C. Sangster, Great Lakes Regional V-P; C. W. McCormick, Northeastern Regional V-P; C. C. Shotwell, Director.

Rolling is fine for Pavements



But

YOU CAN'T "ROLL" PRECISION

into a Prismatic Lighting Unit

"Rolling" is a cost-cutting way of making prismatic glass—acceptable where high quality isn't important . . . This is definitely *not* the Holophane method. We've had six decades of prismatic glass manufacturing experience, and we *know you can't roll* high precision into a glass lens . . . Every HOLOPHANE lens is individually pressed—one by one—on specialized equipment. Only by this process can we make prismatic forms accurate enough to direct light exactly where it should go. HOLOPHANE lenses are the basic components of custom-tailored lighting systems that will provide the specific illumination you require. They give you finer quality, too,—lifetime durability, undeviating performance, and lower cost per unit measured by light delivered . . . When you buy prismatic CONTROLENS*, Refractors or Reflectors look for the name HOLOPHANE impressed on each piece.

The name Holophane is your surest guide to top quality.

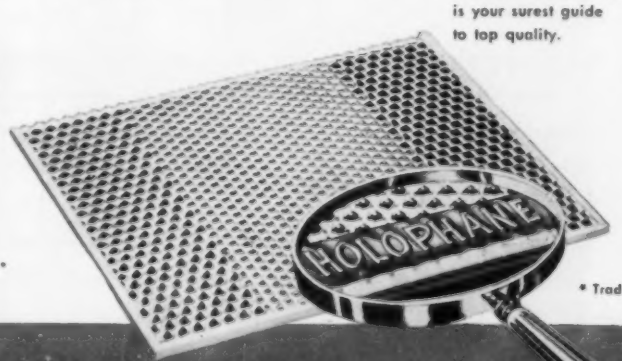
HOLOPHANE

COMPANY, INC. • *Lighting Authorities Since 1898*

342 Madison Ave., New York 17, N.Y.

THE HOLOPHANE CO., LTD., 418 KIPLING AVE. SO., TORONTO 14, ONTARIO

For Better Lighting Holophane *Be Specific . . .*



* Trademark

Jefferson Ballast for 800 MA High Output Fluorescent Lamps

This Jefferson Ballast is designed to give you Full-Rated light output as specified by the lamp manufacturer.

Only Jefferson has succeeded in *designing* and *manufacturing* a ballast for two HO 96T12/RS or two HO 72T12/RS lamps capable of giving *full light* output.

Applications include medium and high bay industrial and commercial locations where high output is required.

It is recommended that surface mounted fixtures be checked for conformance to UL temperature requirements.

Remember—for full light output from the new High Output lamps, insist on Jefferson Ballast No. 254-721!

COMPLETE BALLAST SELECTION DATA

New Technical Bulletin B560-10 gives complete selection data on the entire Jefferson Ballast line in compact, easy-to-use form. Write for your copy today!

PRIMARY 118 VOLTS*—60 CYCLES—HIGH POWER FACTOR

Catalog No.	Watts	Lamps	MA	Approx. Watt Loss	Sound Group	Minimum Operating Temperature	Net Weight
254-721	(2)100/105	(2)96T12/RS	800	38	F	+50°F	13 Lbs.
	(2)85	(2)72T12/RS	800			−20°F	

Length 14 5/16", Width 3⅛", Height 2⅝", Mtg. Centers 13¾".

*For 277 Volt lines, specify Catalog No. 254-728.

Jefferson Electric Company

BELLWOOD, ILLINOIS

(*Continued from page 24A*)

Thoughtful, useful. This was, of course, only one of many favors taken home as souvenirs.

Unscheduled Events

If the ladies had a busy week, the same can certainly be said for the delegates. In addition to a full schedule of technical sessions, some in parallel, almost every meeting room in the hotel was busy with committee meetings.

In lieu of a Regional Conference (because of the national meeting), the Northeastern Region, hosts to the conference, held their Regional MMILJ contest Sunday evening, September 16. There were contestants from each of the four Sections and Chapters in the Region; judges were R. F. Hartenstein, Duncan M. Jones, A. C. Sangster, Joe Thomas, J. D. Mitchell, and Ruby Redford. C. W. McCormick, Regional V-P was the session chairman.

Harold H. Friedman of the Eastern New York Section won the contest, with his installation for a gymnasium. In the running were:

Alonzo Taylor, New England Section — Boston Herald Composing Room.

Harvey Sykes, New York Section — King Super Market, East Orange, N. J.

William P. Carpenter, Connecticut Section — Residential Lighting with a New Concept.

Some of the unscheduled events were gastronomic in nature, Boston being the gourmet's haven it is. To guide the visitor here, one of the Region's sustaining members had prepared a "Guide to Good Eating in Boston" — an item which was well-thumbed before the week was out.

The Historical Committee also provided an unscheduled bit of interest when it placed a 1913 Convention picture in the lobby, with a request for identifications of those shown. This game of "guess-who" brought identification for nearly all of the 200 or so 1913-delegates in the picture. This committee had also prepared a fascinating display of historic old photographs which interested old timers and younger I.E.S. members alike. The display was the work of S. G. Hibben, Chairman of the committee.

MEDALLISTS — present at the conference were five recipients of the I.E.S. Gold Medal, highest honor in illumination. L. to r.: Dr. E. F. Lowry, H. H. Magdsick, W. F. Little, Dr. Ward Harrison, Dr. George S. Crampton.

Credits follow, for the record. To all concerned with this extraordinarily successful conference, however, must come the satisfaction that it will surely be another fifty years before its like can be repeated.

Credits

New England Section, host to this historic Conference, and all its members deserve great credit for the outstanding success of the Fiftieth Anniversary Technical Conference. Most especially, how-

(*Continued on page 28A*)

INVITED speakers at the special Convocation Program included Dr. Brian O'Brien, left, and Dr. R. G. Hopkinson, Dept. of Scientic and Industrial Research, Great Britain.

ANOTHER speaker at the Convocation Program was William Webster, New England Electric System, here shown with incoming President, M. N. Waterman.

(*Continued from page* 27A)

ever, does the Society acknowledge with thanks the work of the following members who were concerned directly with the details of this successful meeting.

NATIONAL TECHNICAL CONFERENCE COMMITTEE
Chairman, J. C. Forbes

C. L. Amick — A. D. Hinckley
W. W. Booth — C. N. Laupp
J. B. Browder — C. W. McCormick
R. B. Brown, Jr. — J. D. Mitchell
H. F. Davidson — J. Ruffatto
C. K. Fulton — L. E. Tayler
J. Thomas

NATIONAL PAPERS COMMITTEE
Chairman, H. F. Davidson

L. E. Barbrow — E. F. Lowry
B. S. Benson — Floyd W. Sell
B. K. Greene — G. A. Trosper
S. K. Guth — H. L. Wright
R. M. Zabel

GOLDEN ANNIVERSARY COMMITTEE
Chairman, R. G. Slauer

Berlon C. Cooper — Julius Daniels
S. G. Hibben — Kirk M. Reid

1956 CONFERENCE EXECUTIVE COMMITTEE
Chairman, R. B. Brown, Jr.
Vice Chairman, R. G. Slauer
Treasurer, W. P. Lowell, Jr.
Coordinators: N. E. Ticehurst
R. F. Townsend
F. J. Vorlander
R. W. Wilson

REGIONAL VICE-PRESIDENT
C. W. McCormick

NEW ENGLAND SECTION CHAIRMAN
W. B. Elmer

COORDINATOR OPERATIONS
N. E. Ticehurst

PUBLICITY COMMITTEE
Chairman, J. F. G. Eichorn, Jr.

W. Allphin — C. R. Southworth
H. R. Loeschner — W. J. Staples
C. A. Russell — J. G. Waddell
R. W. Wilson

FINANCE COMMITTEE
Chairman, W. P. Lowell, Jr.

W. Allphin — J. J. Smith
J. W. Young

TRANSPORTATION COMMITTEE
Chairman, C. M. Holden
Vice-Chairman, E. Quintiliani

REGISTRATION COMMITTEE
Chairman, J. W. Young

H. W. Bassett — R. W. Kelley
R. L. Hebron — R. E. Smith
T. S. Williams

COORDINATOR TECHNICAL PROGRAM
R. F. Townsend

LOCAL PAPERS COMMITTEE
Chairman, C. W. Jerome

W. C. Brown — E. J. Perkins
W. C. Gungle — R. L. Smart
J. Victor

EXHIBITS COMMITTEE
Chairman, D. J. Greaney, Jr.

C. A. George — P. J. Lepore
G. A. Meyers

GUESTS COMMITTEE
Chairman, Julius Daniels

R. D. Barr — W. H. Howard
W. B. Elmer — E. F. Lowry
C. A. B. Halvorson — C. M. Snyder

HISTORIAN — C. A. B. Halvorson

COORDINATOR—FACILITIES — F. J. Vorlander
HOTEL RESERVATIONS COMMITTEE
Chairman, E. O. Kassman

J. J. Donnelly — R. D. Kimball
R. L. Hebron — A. E. Lambert, Jr.

MEETING ROOM COMMITTEE
Chairman, S. Silberberg

L. A. Bean — L. W. Goetz
H. W. Crafts — A. Taylor
H. S. Wilder

LIGHTING AND DECORATIONS COMMITTEE
Chairman, M. H. Kruger

R. Blumenthal — P. L. Crosby
C. H. Capron — E. Frost
P. V. Chandler — B. Jones
J. L. Corrigan — J. F. Maguire
A. E. Reynolds — J. J. Reddington

COORDINATOR—SOCIAL PROGRAM
R. W. Wilson

ENTERTAINMENT COMMITTEE
Chairman, T. C. Sargent

S. L. Baker — L. F. Martin
W. L. Ball — J. Melquist
L. A. Bean — H. M. Nazor
G. M. Burn — R. J. Spaulding
H. H. Homer — W. J. Staples

(*Continued on page* 31A)

Dr. Irving Langmuir — Honorary Member

It is estimated that the Langmuir gas-filled incandescent lamp, one of the achievements for which Dr. Irving Langmuir has been honored by I.E.S., saves the American public $3,000,000 a night, or approximately a billion dollars a year, in electric current costs. By reducing the cost of operating incandescent lights, Dr. Langmuir's development, by the close of World War I, brought electric illumination within the economic reach of almost every American family.

Dr. Langmuir has contributed to several diversified areas of science, winning worldwide recognition as a basic researcher seeking knowledge without having in mind a specific practical application for any disclosure he might achieve.

He won the coveted Nobel prize in chemistry in 1932 for his study of oil films on water through which he developed a means for optically detecting viruses which previously could not be isolated for microscopic examination. Without this great discovery, medical science could not have scored many of its current victories against infection and disease, nor could it have progressed so far in its hopeful research into cancer and other medical mysteries.

A physicist as well as a chemist, Dr. Langmuir was one of a team of researchers who, in recent years, developed a method of inducing rain or snow from certain types of clouds by peppering them with silver iodide or with dry ice.

During World War II, he and Dr. Vincent J. Schaefer developed a technique for producing and laying down a dense screen of smoke to hide the tactical movement of troops and to accomplish what the Chemical Warfare Service hailed as "one of the major triumphs of science in helping fight the nation's war."

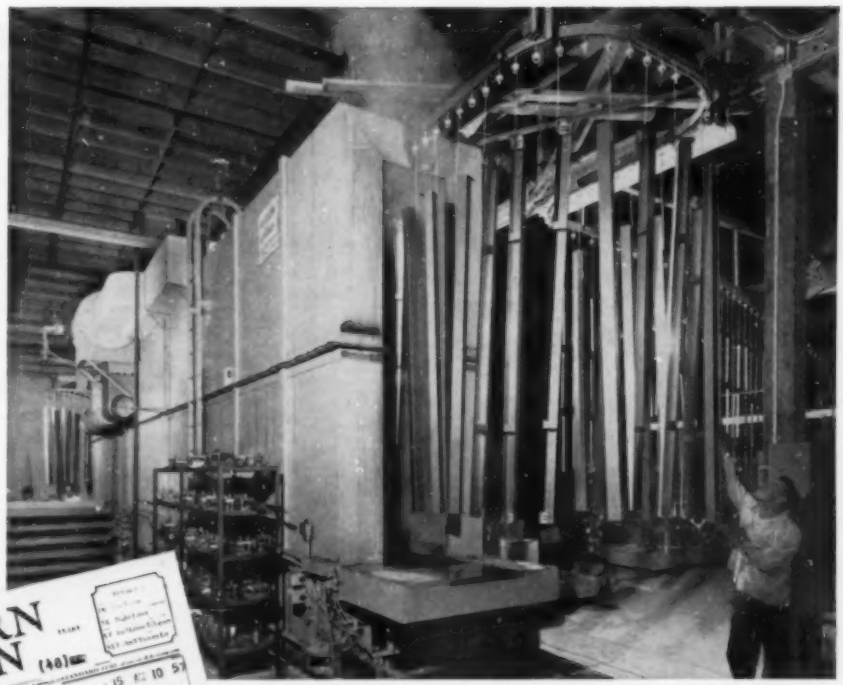
In addition to the gas-filled incandescent electric bulb, Dr. Langmuir's other contributions to the lamp field include the development of the "hot filament," heart of the high-vacuum power tube which modern radio broadcasters acknowledge as the greatest single development in their field. The same device, using high voltage and high vacuum, also was the basis for a new departure in X-ray tubes — the "Coolidge Tube," credited with converting X-Ray diagnosis and treatment from an uncertain art to an exact science.

A few years before he developed the gas-filled incandescent lamp, Dr. Langmuir also contributed to the development of the magnetic electrode with which his laboratory perfected the only street-lighting arc lamp that was able to survive and, for some time, to compete with his later discovery.

Despite his major occupation with such scientific complexities as molecular structure and the chemistry of the atom, Dr. Langmuir's pervading scientific curiosity frequently led him into more plebian fields. He once studied the waves on Lake George in upper New York State to prove that wind was responsible for many convincing reports of "sea serpents." And on another occasion he diligently studied the deer-fly to debunk the respected claim that it could fly at the rate of 800 miles an hour. He proved conclusively it wasn't structurally capable of doing better than 25.

Dr. Langmuir was born in Brooklyn, N. Y., attended public schools there before moving with his family to France, and returned to continue his schooling at Brooklyn's Pratt Institute after several years abroad. After taking his Ph.D., Dr. Langmuir was a lecturer for three years at the Stevens Institute of Technology, Hoboken, N. J., before joining General Electric, which firm he served for 40 years before his retirement in 1950.

All-Brite enameled surfaces surpass government requirements for rust resistance



All-Brite's 57-X Process Washing Machine | Unpainted material entering first stage of washing machine. In background, at left, treated material leaving machine.

WESTERN UNION

0A042
O.NA301 DL PD=FAX NEW YORK NY 15 128PME=
J MACKEY=
1535 COLUMBUS AVE BURLINGAME CALIF=
RETEL FLOURESCENT FIXTURE OF CALIFORNIA SALT SPRAY TESTS
STILL IN PROGRESS ONE PANEL BROKE DOWN 480 HOURS THREE
PANELS STILL RUNNING 528 HOURS NO BREAK DOWN YCT=
OAKITE PRODUCTS INC C W RACK=

Panels treated with the All-Brite 57X process and painted with Formula 44X hot sprayed baked white enamel were placed in a salt spray chamber and tested by ASTM method B-117. The first sign of deterioration appeared after 480 hours thus far surpassing the government specifications calling for 250 hours. All-Brite 57X Cryscoat effectively prevents rust and corrosion from creeping under the paint.

Recognizing the importance of high reflective, durable enamel finish to the efficiency and life of fluorescent fixtures, All-Brite has installed in its new plant the most effective equipment for pre-paint treatment.

The first step in the 57-X process is the spray application of Oakite CrysCoat which removes all oil, grease and dirt from the parts to be painted. The special CrysCoat solution then converts a thin surface layer of metal into a uniform layer of chemically-inert metallic phosphate, which actually becomes a part of the metal surface.

A rinsing operation follows. The addition of chromic acid to the final rinse neutralizes any alkali present, enables the CrysCoat film to "set", and further adds to the paint-adhesive quality of the surface by removing any excess CrysCoat. The chromic acid rinse is a vital step in producing the durability and paint-adhesion called for by All-Brite specifications.

the finest in modern lighting

fluorescent fixtures of california

352 SHAW ROAD • SOUTH SAN FRANCISCO
239 WEST 31ST STREET • LOS ANGELES 7
1318 S.W. FIRST AVENUE • PORTLAND 1

in Canada

ALL-BRITE LIGHTING (B.C.) LTD., 2515 Yukon St., Vancouver, B.C.

All-Brite
LIGHT OF THE WEST

G-E LAMPS GIVE YOU MORE FOR ALL YOUR LIGHTING DOLLARS

You can "measure" the light output of G-E fluorescent lamps, *right in the carton!*

GENERAL ELECTRIC UNIFORMITY IS WHY—G-E 40-watt fluorescent lamps give you all the light you pay for. Their light output is so uniform that you're assured of their performance—even before you put one in a socket. There's practically no such thing as a "lazy" G-E lamp—a lamp that uses full power without delivering its rated lumen output. Less than 1% of all General Electric 40-watt fluorescent lamps are as much as 5% below their average published light output of 2500 lumens.

G-E LAMPS SAVE YOU MONEY—Today's General Electric 40-watt fluorescent lamps deliver 30% *more* light than those you bought in 1950. Based on the average cost of burning 24 G-E 40-watt fluorescent lamps, this gives you a *bonus of light* worth almost $55! Put another way, this *extra* light equals the total light output of 79 100-watt incandescent bulbs over their entire life!

But G-E lamp uniformity means more than uniform *light* output. It also means freedom from defects—on the average, 99.9% of all G-E 40-watt fluorescent lamps are free from physical defects that could affect performance in service. And uniform life, too, means that after one year of service in single shift plants (2500 hours) an average of 99 out of 100 General Electric 40-watt fluorescent lamps will still be burning—98 out of 100 will still be in service after a year in double shift plants (4000 hours).

For more information on what uniformity in G-E fluorescent lamps means to you write: General Electric Co., Large Lamp Dept. **IE-11**, Nela Park, Cleveland 12, O.

Progress Is Our Most Important Product

GENERAL ELECTRIC

SOME of the 100 Canadians present at Boston.

(*Continued from page* 28A)

LADIES RECEPTION COMMITTEE
Chairman, Mrs. H. M. Nazor

Mrs. G. B. Almy	Mrs. C. A. McKenna
Mrs. R. D. Barr	Mrs. A. H. Rogers
Mrs. R. B. Brown, Jr.	Mrs. T. C. Sargent
Mrs. J. L. Corrigan	Mrs. R. G. Slauer
Mrs. J. Daniels	Mrs. R. L. Smart
Mrs. C. I. Dwinell	Mrs. J. J. Smith
Mrs. J. F. G. Eichorn, Jr.	Mrs. C. M. Snyder
Mrs. W. B. Elmer	Mrs. N. E. Ticehurst
Mrs. C. A. B. Halvorson	Mrs. R. F. Townsend
Mrs. C. M. Holden	Mrs. F. J. Vorlander
Mrs. W. K. Lewellen	Mrs. R. W. Wilson
Mrs. W. P. Lowell	Mrs. J. W. Young

SPORTS COMMITTEE
Chairman, H. J. Wilson

R. D. Barr — C. I. Dwinell
L. A. Murphy

CONTRIBUTING MEMBERS TO PYLON

Aluminum Company of America
Boston Edison Company
City of Boston
Eastern Fixture Company
General Electric Company
Holophane Company, Inc.
Litecontrol Corporation
Mobeco, Inc.
Plax Corporation
Smithcraft Lighting Division
Stonco Electric Products Company
Sylvania Electric Products, Inc.
Wheeler Reflector Company
Zane Manufacturing Company

1956 Conference Program

Monday, September 17

National Officers Report

Presiding, J. C. Forbes, Chairman, National Technical Conference Committee

Greetings from City of Boston — Mayor John B. Hynes.
Address of Welcome—T. G. Dignan, President, Boston Edison Co.
Report of the General Secretary—G. J. Taylor.
President's Address — R. F. Hartenstein, President, I.E.S.
Our Society in 1956-1957 — M. N. Waterman, President-Elect of I.E.S.
Introduction of 1956 Fellows — President Hartenstein.

Daylighting Session

Presiding, B. F. Greene

Daylighting Design with Adjustable Horizontal Louvers — J. W. Griffith, W. J. Arner and E. W. Conover, Southern Methodist University, Dallas, Texas; Libbey-Owens-Ford Glass Co., Toledo, Ohio; and Fenestra, Inc., Detroit, Mich., respectively.
Availability of Daylight — H. F. Kingsbury, H. H. Anderson, and V. U. Bizzaro, Pittsburgh Corning Corp., Port Allegany, Pa.
Measurements in Daylighted Classrooms in Arizona — J. R. Williams, Arizona Public Service Co., Phoenix, Ariz.

Applications I Session

Presiding, B. S. Benson, Jr.

Interior Lighting with High Output Fluorescent Lamps — W. H. Johnson, Westinghouse Electric Corp., Cleveland, Ohio.
Some Factors that Influence the Design of Exposed Lamps for Daytime Effectiveness — A. L. Hart, General Electric Co., Cleveland, Ohio.
Lighting for Audio-Visual Teaching — Carl J. Allen, General Electric Co., Cleveland, Ohio.
A Uniform Light Source Excited by Radio Frequency — S. C. Peek, Sylvania Electric Products Inc., Salem, Mass.

Tuesday, September 18

Residence Lighting Forum

Presiding, Miss Ruth Morris

Planning Lighting with the Home-owner — Miss Emily Alexander and Miss Nina F. Bonner, Atlanta Division, Georgia Power Co.
Light for Living Indoors and Out — Nelson J. Bleisch, Union Electric Co. of Mo.
Designed Lighting for Texas Homes — Miss Ruth Patterson, Dallas Power & Light Co.

Calculations Session

Presiding, S. K. Guth

Interflections in a Room with Luminous Walls — H. S. Bull, University of Michigan, Ann Arbor, Mich.
Analysis of Experimental Data for Interflectance Theory — R. S. Wiseman, Engineer Research and Development Laboratories, Fort Belvoir, Va.
Algebraic Interflectance Computations — J. R. Jones, Westinghouse Electric Corp., Los Angeles, Calif.; J. J. Neidhart, The Miller Company, Meriden, Conn.
The Effect of Furniture on the Coefficient of Utilization — Domina E. Spencer, University of Connecticut, Storrs, Conn.

Light Sources I Session

Presiding, Floyd Sell

Characteristics and Application of Axial Filaments — C. W. Pearson, E. A. Linsday and R. T. Dorsey, General Electric Co., Cleveland, Ohio.
Fluorescent Lamp Performance as Affected by Impurity Gases — R. W. Mooney and W. C. Gungle, Sylvania Electric Products Inc., Towanda, Pa., and Salem, Mass., respectively.
Factors To Be Considered in the Design of High Output Fluorescent Lamps — J. F. Waymouth and E. F. Lowry, Sylvania Elec-

(*Continued on page* 32A)

I.E.S. National Technical Conferences

1957 — September 9-13 — Biltmore Hotel, Atlanta, Georgia

1958 — August 17-22 — Royal York Hotel, Toronto, Ontario

1959 — September 7-11 — Hotels Fairmont and Mark Hopkins, San Francisco, California

(Continued from page 31A)

tric Products, Inc., Salem, Mass.; and Francis Bitter, Massachusetts Institute of Technology, Cambridge, Mass.

Operating Parameters of High Output Fluorescent Lamps — W. C. Gungle, H. H. Homer, and J. F. Waymouth, Sylvania Electric Products Inc., Salem, Mass.

Fiftieth Anniversary Convocation

Presiding, President R. F. Hartenstein

Procession — Past Presidents, Fellows, Medalists and Honorary Member.

Acknowledgment of Fellows.

Recognition of leaders in other professions whose work has facilitated the advancement of illuminating engineering.

Award of I.E.S. Medal
Introduction — Ward Harrison
Chairman, Medal Committee
Presentation — President Hartenstein
Response — Dr. George S. Crampton

Presentation — Certificate of Honorary Membership by President Hartenstein.

Response — Dr. Irving Langmuir.

Convocation Papers Session

Presiding, M. N. Waterman

Atomic Power for Tomorrow's Lighting — A Key to Seeing — William Webster, Executive Vice-President, New England Electric System.

Assessment of Brightness — What We See — Dr. R. G. Hopkinson, Department of Scientific and Industrial Research, Garston, England.

Visual Reception — How We See — Dr. Brian O'Brien, Director of Research, American Optical Co.

Progress Report (Tuesday Evening)

Chairman, J. H. McCulloch

Part I — 1956 Highlights, conducted on the main stage.

Part II — Lightorama, Individual stages, on each side of the ballroom, manned by members of the Progress Report Committee.

Wednesday, September 19

Presentation of Certificates of Merit to students in Allied Art Exhibition by Karl A. Staley, Chairman of Committee.

My Most Interesting Lighting Job Contest — *Presiding*, Lee E. Tayler, Detroit Edison Co.

Judges: E. W. Commery, C. L. Crouch, R. F. Hartenstein, S. G. Hibben, M. N. Waterman.

Regional Winners:

Canadian:	R. S. Tate Floodlighting of St. Joseph's Oratory
East Central:	Miss E. A. Meehan Lighting a Residence
Great Lakes:	G. H. Seiter Floodlighting an Office Building
Inter-Mountain:	C. D. Bell Lighting a Jewelry Store
Midwestern:	E. H. Schaefer The Light is Right at Mutual
Pacific Northwest:	Miss Dorothy McGregor Ease of Living Home
South Pacific Coast:	B. F. Jones Airesearch Co. Engineering Office
Southern:	L. N. Goodman Lighting Variety in a Modern Building
Southwestern:	Miss Ruth Patterson Lighting a Stained Glass Window
Northeastern:	Harold Friedman Lighting a Gymnasium

Thursday, September 20

Applications II Session

Presiding, L. E. Barbrow

Mercury Floodlighting — Its Advantages and Limitations — J. R. Bale, Westinghouse Electric Corp., Cleveland, Ohio.

Flashing Characteristics of Fluorescent Lamps — J. H. Campbell and D. D. Kershaw, General Electric Co., Cleveland, Ohio.

Flashing Applications of Fluorescent Lamps — R. W. Bunner and R. T. Dorsey, General Electric Co., Danville, Ill. and Cleveland, Ohio, respectively.

Light Sources II Session

Presiding, Dr. E. F. Lowry

The Efficiency of Electroluminescence — W. Lehman, Westinghouse Electric Corp., Bloomfield, N. J.

New Developments in Short Arc Lamps — T. C. Retzer and G. W. Gerung, Westinghouse Electric Corp., Bloomfield, N. J.

The Effect of Outer Jacket Fill Pressure and Arc Tube Pressure on Mercury Lamp Performance — J. M. Harris, Sylvania Electric Products Inc., Salem, Mass.

Phosphors for High Pressure Mercury Vapor Lamps — M. J. B. Thomas, K. H. Butler and J. M. Harris, Sylvania Electric Products Inc., Salem, Mass.

Research Session

Presiding, Dr. R. M. Zabel

Lighting Requirements for Older Workers — S. K. Guth, A. A. Eastman and J. F. McNelis, General Electric Co., Cleveland, Ohio.

The Evaluation of Discomfort Glare — G. A. Fry, School of Optometry, Ohio State University, Columbus, Ohio.

"EFAS" — A New and Vital Aid to Low Visibility Landings by Aircraft — D. I. Coggins, Sylvania Electric Products Inc., Salem, Mass.

Street Lighting Session

Presiding, George K. Glass

A New Approach to Highway Tunnel Lighting — John R. Brass and Harold Skootsky, California State Highway Dept., San Francisco, Calif.; and G. A. Trosper, Pacific Gas & Electric Co., San Francisco.

A Highway Lighting Test Installation — G. A. Nagel, Connecticut State Highway Department, Hartford, Conn.

Some Factors Influencing the Night Visibility of Roadway Obstacles — D. M. Finch, University of California, Berkeley, Calif.

Discomfort Glare at Low Adaptation Levels — Part II: Off Axis Sources — R. C. Putnam and Willard F. Gilmore, Jr., Case Institute of Technology, Cleveland, Ohio.

Council Meets in Boston — Summary of Action Taken

The first meeting of the 1956-1957 Council of I.E.S. was held in Boston, September 21, with Marshall N. Waterman, President, presiding. The meeting date was a departure from the usual practice of holding the first meeting of the administrative year in October. Its schedule during the same week as the National Technical Conference in Boston, however, paid off with almost 100 per cent attendance of all Council members, incoming and outgoing. There were no proxies.

Committee personnel appointments for the 1956-1957 Standing, General and Technical Committees were approved. Preprinted lists of committees and their chairmen will be distributed to Committee Chairmen during November; up-to-date committee lists will be published in I.E. in the April 1957 issue.

Detailed budget for the coming fiscal year, as studied and approved by the Finance Committee was presented to Council for further discussion in relation to past budgets and estimates for the current year. The budget as recommended by the Finance Committee was approved by Council.

John J. Neidhart, Chairman of the newly appointed I.E.S. Lighting Handbook Committee reported to Council on proposals of this Committee for the preparation of the new Handbook, aiming at publication in January 1958. He sought approval of the operational procedure outlined by him. Approved.

Plans for the Membership Committee during the next year were reported by Brooks Chassaing. This Committee will have five members at large, plus Regional and Section/Chapter representatives. This "team" will have as its goal a total of 2400 new members, lowered membership losses to 600 maximum, and a lower ratio of Associate to Member grade.

George J. Taylor, Vice-President, and Chairman of the Regional Activities Committee reported action taken by his Committee which met in Boston Sunday, September 16th. Action of Council included approval of changes in the Ottawa Chapter boundary, and approval of a charter for a new Chapter (St. Maurice) in Quebec Province, pending completion of petition and final qualifications.

J. C. Forbes, Chairman of the National Technical Conference Committee, told Council that several bids for future National Technical Conferences had been received. These will be studied by his Committee, and recommendations made for action of Council in November.

New Sustaining Members presented by Fred Guth, Chairman of the S-M Committee, were approved, as follows:

Wilson Electrical Equipment Co.
P.O. Box 1725
Houston, Texas
Official Representative: Dallas L. Calmes

(Continued on page 35A)

new luminaire . . .

with light-control lens of Plexiglas

Molded of PLEXIGLAS® acrylic plastic, the prismatic enclosure of this recently introduced fluorescent luminaire contributes many basic design advantages:

Light Weight and Strength make possible a simplified design notable for the absence of heavy metal framing . . . resulting in slim, compact, architecturally harmonious appearance. The entire lens section is hinged, can be swung down for easy relamping and cleaning.

Shatter Resistance makes the luminaire especially suitable for locations where safety is a prime requisite.

Precise Moldability to the lens pattern results in an efficient optical element that provides a high level of downward light and, at the same time, complete visual comfort.

Dimensional Stability and Freedom from Discoloration insure long term efficiency, beauty and economy.

Write today for the names of manufacturers of fluorescent luminaires featuring molded PLEXIGLAS enclosures.

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Canada.*

FLORA BALLAST* SHOWS how easy it is to make across-the-counter in-warranty replacement of G-E ballasts at no cost to you, from your nearby G-E Ballast Service Center Distributor. They carry ample stocks of G-E ballasts from which you can select replacements for any make ballast.

Flora explains how . . .*

More Than 800 G-E Ballast Service Centers Help You Save Lighting Dollars

When it is necessary to obtain an immediate ballast replacement you'll get prompt service at the G-E Ballast Service Center Distributor located nearest you. The complete stocks and convenient location help you save time and money. There are G-E Ballast Service Centers in every major city—more than 800 of them in the United States. Here you can make NO CHARGE in-warranty replacements of G-E ballasts . . . and replace *any make* ballast with a high quality G-E unit. And G.E. gives you top quality at low attractive prices too. Save time and money—solve your ballast replacement problems at your nearest G-E Ballast Service Center.

When you buy G-E ballasts you get other services too. G.E. maintains a network of national warehouses to speed volume orders. More than 150 trained sales engineers from G-E Apparatus Sales Offices are available to give you help in applying G-E ballasts and in servicing G-E ballast installations.

A G-E ballast tag or sticker on your fixture is proof that it is equipped with the best in ballast value. It's the easy way to be certain. For a complete presentation on G-E ballasts, contact the G-E Apparatus Sales Office nearest you or write Section 401-16, General Electric Company, Schenectady 5, New York.

*Miss Fluorescent Ballast, G.E.'s Ballast Mascot

Copyright 1955, General Electric Company

EXPERIENCED G-E BALLAST ENGINEERS are available to help you plan and service fluorescent lighting applications. For help, contact your nearest G-E Apparatus Sales Office.

Five more reasons why

GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- EXCLUSIVE SOUND RATING SYSTEM
- SUPERIOR QUALITY CONTROL
- LONGER BALLAST LIFE
- PRECISE LAMP-MATCHED DESIGN
- PROVED PRODUCT LEADERSHIP

Progress Is Our Most Important Product

GENERAL ELECTRIC

(Continued from page 32A)

Northern Berkshire Electric Co.
21 Bank St.
North Adams, Mass.
Official Representative: Bart D. Barry

Grand Light & Supply Co.
833 State St.
New Haven, Conn.
Official Representative: Malcolm Rosen

Flood-Lite Service Inc.
212 Silver Lake Blvd.
Los Angeles, Calif.
Official Representative: Benn J. Hartmann

Bakelite Co.
Division of Union Carbide & Carbon Corp.
230 N. Michigan Ave.
Chicago, Ill.
Official Representative: A. J. Dragonette

Activities of Technical Committees of the Society were reported by C. L. Crouch. In this connection the General Secretary reported on Council's letter ballot covering:

(a) Amendment of By-Laws articles 2, 3, 4 and 7. Approved.

(b) "Lighting for Sawmills: Redwood Green Chain." Approved.

J. R. Chambers, Chairman of the Public Relations and Information Committee outlined to Council the need for an organized program to familiarize the public and other organizations with the aims and work of the Illuminating Engineering Society. He indicated that details of such a program will be reported at a later Council meeting and meanwhile urged approval of an adequate budget to carry out this program.

Future dates of Council meetings were established as follows: December 13th in New York, February 14th in New York, April 18th in New York and June 12th in New York.

Certified Lighting Program Organizes Inland Empire Bureau

Organization of the Inland Empire Certified Lighting Bureau, serving roughly the eastern half of the State of Washington, has been announced by Laurance C. Messick, Manager of the National Lighting Bureau. Headquarters for the program are in Spokane.

Sponsoring organization is the Inland Empire Electrical League with a special executive committee consisting of L. M. Stewart, Chairman, Maxwell's Inc.; B. E. Plowman, Washington Water Power Co.; R. L. Wilkinson, National Electrical Contractors Association; David Moses, General Electric Supply Co.; and Walter Haspedis, Columbia Electric and Manufacturing Co.

The training program, of eight classes held at Gonzaga University, began October 25. T. W. Beadle, illuminating engineer with Washington Water Power Co., is designated Certification Authority.

The Spokane Bureau is the eighteenth

(Continued on page 36A)

SCHEDULED EVENTS

1956

November 15-16, 1956—Operations Research Society of America, Tenth National Meeting, Hotel Mark Hopkins, San Francisco, Calif.

December 13, 1956 — I.E.S. Council Meeting, New York, N. Y.

1957

January 21-25, 1957 — American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York, N. Y.

January 28-31, 1957 — Plant Maintenance & Engineering Conference, Public Auditorium, Cleveland, Ohio.

February 14, 1957 — I.E.S. Council Meeting, New York, N. Y.

February 17-20, 1957 — National Electric Sign Association, Annual Convention and Exhibit, Sheraton Park Hotel, Washington, D. C.

February 25-28, 1957 — American Society of Heating and Air-Conditioning Engineers, 63rd Annual Meeting, Chicago, Ill.

February 25 - March 1, 1957 — 13th International Heating and Air-Conditioning Exposition, Chicago, Ill.

March 11-14, 1957 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

March 28-29, 1957 — Pacific Northwest Regional Conference, Illuminating Engineering Society, Empress Hotel, Victoria, B. C.

April 3-5, 1957 — South Pacific Coast Regional Conference, Illuminating Engineering Society, Hotel Statler, Los Angeles, Calif.

April 8-11, 1957 — Fourth National Electrical Industries Show, 71st Regiment Armory, New York, N. Y.

April 11-12, 1957 — Inter-Mountain Regional Conference, Illuminating Engineering Society, Hilton Hotel, Albuquerque, N. M.

April 18, 1957 — I.E.S. Council Meeting, New York, N. Y.

April 28-30, 1957 — Southwestern Regional Conference, Illuminating Engineering Society, Holiday Inn, Oklahoma City, Okla.

April 28 - May 3, 1957 — Society of Motion Picture and Television Engineers, Shoreham Hotel, Washington, D. C.

May 6-8, 1957 — Air Conditioning and Refrigeration Institute, Annual Meeting, The Homestead, Hot Springs, Va.

May 9-10, 1957 — Midwestern Regional Conference, Illuminating Engineering Society, Hotel Pfister, Milwaukee, Wis.

May 13-14, 1957 — Great Lakes Regional Conference, Illuminating Engineering Society, Pantlind Hotel, Grand Rapids, Mich.

May 16-17, 1957 — Canadian Regional Conference, Illuminating Engineering Society, Hotel Sheraton Brock, Niagara Falls, Ont.

May 23-24, 1957 — East Central Regional Conference, Illuminating Engineering Society, William Penn Hotel, Pittsburgh, Pa.

June 4-6, 1957 — Chicago Electrical Industry Show, Conrad Hilton Hotel, Chicago, Ill.

June 12, 1957 — I.E.S. Council Meeting, New York, N. Y.

June 12-13, 1957 — Northeastern Regional Conference, Illuminating Engineering Society, Hotel Statler, New York, N. Y.

June 24-28, 1957 — American Institute of Electrical Engineers, Summer General Meeting, Montreal, Que.

August 28-30, 1957 — American Institute of Electrical Engineers, Pacific General Meeting, Yakima, Wash.

September 9-13, 1957 — Illuminating Engineering Society, National Technical Conference, Biltmore Hotel, Atlanta, Ga.

October 6-11, 1957 — Society of Motion Picture and Television Engineers, Hotel Statler, New York, N. Y.

October 7-11, 1957 — American Institute of Electrical Engineers, Fall General Meeting, Chicago, Ill.

October 21-25, 1957 — National Safety Council, 45th National Safety Congress & Exposition, Chicago, Ill.

November 11-15, 1957 — National Electrical Manufacturers Association, Traymore Hotel, Atlantic City, N. J.

November 18-21, 1957 — 10th Exposition of the Air-Conditioning and Refrigeration Industry, Navy Pier, Chicago, Ill.

Deadline — February 1, For 1957 Conference Paper Outlines

A deadline of February 1 has been set, by the I.E.S. Papers Committee, for outlines of proposed papers for the 1957 National Technical Conference. Outlines of proposed papers, in triplicate, should be mailed to:

H. F. Davidson, Chairman
I.E.S. Papers Committee
c/o Hydro-Electric Power Commission of Ontario
620 University Avenue
Toronto 2, Ontario, Canada

(Continued from page 35A)

to be organized under the National Certified Lighting Program, which is sponsored by the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association.

Other Certified Lighting activity includes the Fourth Lighting Course to be scheduled by the Lighting Bureau of the Electric Institute, Inc., Boston. The eight weekly sessions of the training course are taking place October 10 through December 5, November 21 excepted, at the Edison Auditorium in Boston. R. L. Smart, Boston Edison Co., R. F. Townsend, Westinghouse Lamp Division, and L. S. Cooke, General Electric Co. Lamp Department, are instructors. Julius Daniels is Chairman of the Lighting Bureau.

I.E.S. Gold Medal Nominations Due by January 1

According to official I.E.S. Procedure, nominations for the I.E.S. Gold Medal Award must be received at Society Headquarters no later than January 1, for consideration by the 1956-1957 Committee.

Any member wishing to suggest a candidate may do so by addressing a letter to the Medal Award Committee, in care of Headquarters. No details as to the candidate's qualifications are needed in this letter. Complete Medal Award Procedure has been sent to the Chairmen of all Sections and Chapters in October. Reference may be made to these circulated copies, or copies available from the Executive Secretary, upon request.

Competition to Spur Philadelphia Membership Drive

In an all-out effort to improve its standing in the I.E.S. membership drive, the Philadelphia Section is engaged in an intra-Section Competition of teams composed of (1) Officers of the Section, (2) Past-Chairmen (and 3) other members in three groups by last name, A-G, H-O and P-Z. Cash prizes are being offered for teams and individuals.

Deadline Announced for EEI Awards Entries

A deadline of February 15 has been set for entries in the 1956 Lighting Awards contests presented through Edison Electric Institute for both lighting education and lighting promotion. The contests are open to investor-owned operating electric utility companies.

The Better Light Better Sight Bureau Awards are for noteworthy educational activities which foster a better understanding of the relationship of light and sight. Two awards are available — for companies with under and over 250,000 total meters.

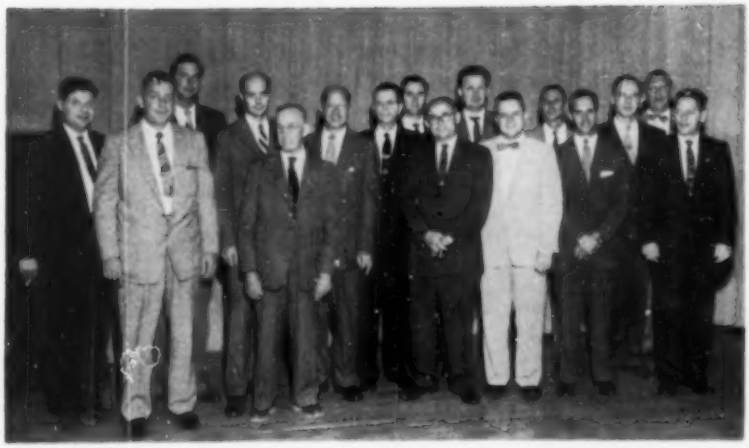
The Lighting Promotion Awards recognize outstanding lighting promotional activities in the residential and commercial-industrial markets. There are two: one for residential and one for commercial-industrial lighting promotion.

Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y., will supply information on rules, terms and conditions.

"Housepower" Forums Campaign To Modernize Home Wiring

"Housepower" Forums on Residential Wiring, produced by the Edison Electric Institute in cooperation with the National Electrical Contractors Association, are being scheduled as part of an overall campaign by EEI in its efforts to bring wiring modernization to an estimated 20,000,000 American homes during the next ten years.

The forums, a series of six 2-hour meetings or three 3-hour meetings, are being offered at nominal cost to contractors by participating EEI member utilities. Liberal use is made of visual sales methods and group discussion stimuli, according to Porter Henry & Co., who developed the programs.



OFFICERS and Committee Chairmen of the Southern California Section at the first meeting of the new year, September 5, are left to right: Sydney I. Meyerson, G. A. Hochenauer, Audie Ashcraft, E. J. Fraser, Wm. P. Bear, Oscar Meissner, Merle Potter, Don Romanoff, Benn Hartmann, Roy Bevan, Roy Jones, Ralph Weston, Alleson B. Clubley, Dan Finch, Roy Kreyser and Don Dressen.

PAST-CHAIRMAN pin is presented to Roy Kreyser by G. A. Hochenauer, incoming Chairman of the Southern California Section, I.E.S.

Twin City Section Presenting Lighting Fundamentals Course

Basic Illumination — Fundamentals and Applications is a ten-week course being presented by the education committee, Conrad J. Aas, Chairman, of the Twin City Section of I.E.S. Classes, which began October 10 and continue through December 12, are being held in the Lighting Demonstration Room, Northern States Power Co., Minneapolis. O. C. Oberg is instructor.

(Continued on page 39A)

Announcing . . .

a new hinged design*
in ceiling
pan fixtures by

PERFECLITE

Perfeclite now offers a new **hammer lock** design in incandescent ceiling pan lighting fixtures. No other ceiling pan fixture on the market today has all these engineering features:

- Globe opens on **hinge** for quick easy cleaning and relamping.
- Unique **safety locking fitter** holds globe in place without bothersome screws, unsightly extensions or trick springs. Globe is secured with lugs by simple twist of the wrist.
- Lip of globe is completely protected against breakage by a **steel protector ring.**
- Provides **ceiling illumination** as well as **evenly distributed floor lighting.**
- Minimum amount of metal, maximum amount of glass results in **highest light efficiency.**

Here is a unique ceiling pan fixture design for either commercial or residential installation. For further information send for The Perfeclite Data Sheet 56-C today.

Perfeclite's new **hammer lock** fixture is available in the following sizes:

Model	Glass Diameter	Wattage
HH-9	8″	2- 40 W
HH-11	10″	2- 60 W
HH-13	12″	2- 75 W
HH-15	14″	2-100 W
HH-17	16″	3-100 W

Send for new Perfeclite Catalog 956 giving full information on our entire line of Commercial Incandescent Fixtures and Exit Units.

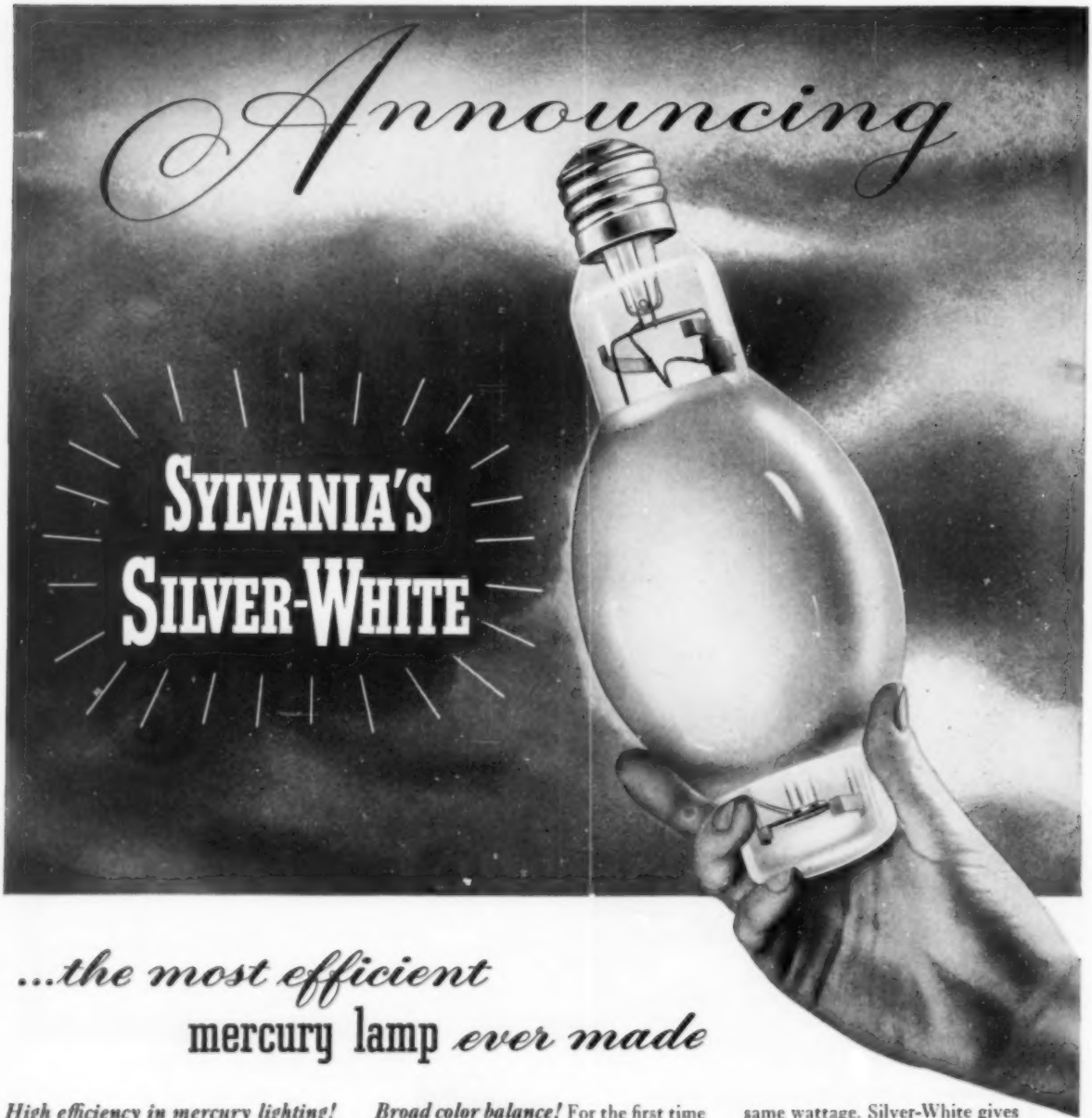
Fixtures are Underwriters Laboratories, Inc. approved.
*Patent pending

THE PERFECLITE COMPANY
1457 East 40th Street • Cleveland 3, Ohio

PERFECLITE PRODUCTS — THE MARK OF LIGHTING SERVICE

☐ Please send me The Perfeclite Data Sheet 56-C.
☐ Please send me the new Perfeclite Catalog 956.

Name.....
Address.....
City..... .....State.....



...the most efficient mercury lamp ever made

High efficiency in mercury lighting! In the search for better light, Sylvania's scientists have developed new phosphors that enable the Silver-White mercury lamp to produce 10 to 20 per cent *more* light than clear mercury lamps.

The new phosphor in this bulb actually *adds* light, where previous "color improvements" subtracted from the light of the ordinary clear mercury lamp. The silver-white coating on this bulb diffuses and softens the tremendous light output. No other type of mercury lamp gives you so much light for your lighting dollar.

Broad color balance! For the first time in mercury lighting you get radiation across the whole width of the color spectrum.

Lighting costs are reduced! The 400-watt Silver-White mercury lamp gives on the average 7 times the burning hours of life as compared with incandescent of the same wattage.

Sylvania's Silver-White mercury lamps are now available in ratings of: 100-watt, 175-watt and two 400-watt types. They cost no more than other color-corrected mercury lamps of the same wattage. Silver-White gives you brilliant, high efficiency lighting in the factory, service station, parking lot, and in street and highway lighting.

Our commercial engineering department will be glad to help you with your special application or installation problems. For complete technical data write directly to:

SYLVANIA ELECTRIC PRODUCTS INC.
Lighting Division, Salem, Mass.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building, St. Catherine Street, Montreal, P. Q.

SYLVANIA®

... fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

(Continued from page 36A)

The following topics are being covered during the classes:

October 10 — Mechanism of the Human Eye; Light and Vision; Illumination Terminology.
October 17 — Light Sources — Incandescent and Electric Discharge.
October 24 — Fluorescent Lamps.
October 31 — Introduction to Lighting Design.
November 7 — Importance of Color in Illumination; Basic Lighting Cost Analysis; Miscellaneous Fundamentals.
November 14 — Office and School Lighting.
November 21 — Architectural Lighting; Store Lighting.
November 28 — Industrial Lighting; Floodlighting.
December 5 — Cost and Maintenance of Lighting; Miscellaneous Lighting Application.
December 12 — Review and Final Examination.

ABOUT PEOPLE

Westinghouse Electric Corp. has announced the reorganization of its Lamp Division into five major product departments, each headed by a manager responsible for all phases of the business. The new products departments and their managers are: Large Lamp Dept., **Charles E. Erb**; Miniature Lamp Dept., **Charles W. Flood, Jr.**; Photolamp Dept., **Joseph Schlig**; Lamp Parts Dept., **Elwood W. Noxon**; and Ken-Rad Lamp Dept., **Joseph G. Carroll.** With the exception of the Ken-Rad Lamp Dept., which is located at Owensboro, Ky., all managers will make their headquarters at Bloomfield. In addition to the product department managers, several staff heads responsible for overall coordination of key functions will report to **F. M. Sloan,** vice-president. These include: **L. J. Fitzpatrick,** manager of operations; **James E. Woodall,** manager of manufacturing; **Dr. R. M. Zabel,** manager of engineering; **John E. Fox,** manager of industrial relations; **Wallace R. Wirths,** manager of public relations.

The Directors of Pittsburgh Reflector Co. have announced the appointment of **Robert C. Zinsmeister** as President of the firm. Mr. Zinsmeister was formerly Plant Manager of the company's Irwin, Pa., plant. At the same time, the company appointed **Donald J. O'Neil** as Assistant Secretary and Assistant Treasurer. Mr. O'Neil has been with the company for the past eight years as a Cost Accountant and Assistant to the Executive Vice-President.

The appointment of **Thomas M. Wallace** as manager of manufacturing for the General Electric Co.'s Large Lamp Dept., Nela Park, has been announced. Mr. Wallace, formerly manager of manufacturing for the Miniature Lamp Dept., succeeds **Henry F. DeLong,** who moves up to the position of general manager of the Cathode Ray Tube Department of the G-E Electronics Components Division in Syracuse. Succeeding Mr. Wallace in his former position is **Donald J. Mayer,** promoted from his post as manager of Large Lamp Warehousing and Field Services.

Frank M. Tait, chairman of the board of the Dayton Power and Light Co. and the Tait Manufacturing Co., has been made a fellow of the Royal Society of Arts, established in London in 1754 for "the encouragement of arts, manufactures and commerce." Mr. Tait was elected to the society in recognition of his long career in manufacturing businesses, electric power production and gas companies.

Dr. John S. Saby has been appointed manager of the Lamp Research Laboratory of General Electric's Advanced Lamp Development Laboratory at Nela Park, Cleveland. Dr. Saby joined G-E as an electronics laboratory physicist in 1951. He was manager of the semi-conductor and solid state group in Syracuse until his present appointment.

Several awards were announced by the Society of Motion Picture and Television Engineers at their 80th convention in Los Angeles early in October. **Dr. Alfred Norton Goldsmith,** motion picture and television consultant was selected by SMPTE as the 1956 recipient of its highest award, the Progress Medal. The David Sarnoff Gold Medal for 1956 was awarded posthumously to **Robert E. Shelby,** Vice-President and Chief Engineer of the National Broadcasting Co. until his death in December 1955. The Journal Award was presented to **Donald G. Frink,** Director of Research for the Philco Corp. **Dr. Wesley T. Hanson, Jr.,** Head of the Color Photography Division of Eastman Kodak Research Laboratories was selected as the first recipient of the SMPTE Herbert T. Kalmus Gold Medal Award. Honorary membership in the society has been awarded to **Dr. Alexander Ernemann,** former member of the Board of Directors of Zeiss Ikon AG., Stuttgart, Germany, for his outstanding contributions to cinematography during the past 52 years.

Manufacturing facilities of the General Electric Co.'s Laminated and Insulating Products Dept., in Schenectady, N. Y., have been assigned to the Chemical and Metallurgical Division's Chemical Materials Dept., to form a special insulating materials section. **Louis E. Newman** has been appointed manager of this newly-formed section.

Carroll L. O'Shea has been elected president of the Electrical Associates, Inc., an organization founded in 1928 of men from all branches of the electrical industry in the New York City metropolitan area. Mr. O'Shea, who succeeds **C. Ashmead Biddulph** as president of the group, is with the Lamp Division of the General Electric Co. He is a past chairman of the New York Section of I.E.S.

(Continued on page 40A)

1957 Regional Conferences, I.E.S.

Region	Place	Date
Pacific Northwest	Empress Hotel Victoria, British Columbia	March 28-29
South Pacific Coast	Statler Hotel Los Angeles, California	April 3-5
Inter-Mountain	Hilton Hotel Albuquerque, New Mexico	April 11-12
Southwestern	Holiday Inn Oklahoma City, Oklahoma	April 28-30
Midwestern	Pfister Hotel Milwaukee, Wisconsin	May 9-10
Great Lakes	Pantlind Hotel Grand Rapids, Michigan	May 13-14
Canadian	Sheraton Brock Hotel Niagara Falls, Ontario	May 16-17
East Central	William Penn Hotel Pittsburgh, Pennsylvania	May 23-24
Northeastern	Statler Hotel New York, New York	June 12-13

(*Continued from page 39A*)

The appointment of **David H. Nelson** to assistant to the region sales manager of the southwestern area for the Westinghouse Lamp Division has been announced by **Frank C. Cline,** region sales manager for that area. Mr. Nelson will make his headquarters at the company's sales offices at 411 North 7th St., St. Louis, Mo.

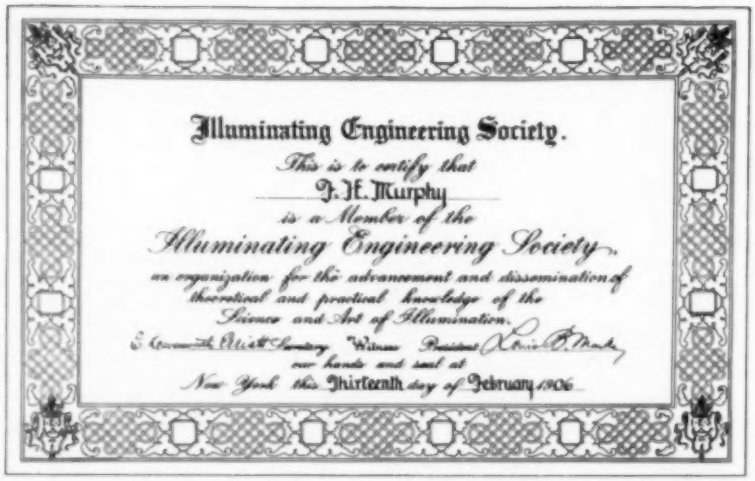
Fluorescent Fixtures of California announces the establishment of a branch assembly plant at Vancouver, B. C., which will be known as All-Brite Lighting (B. C.) Ltd. Vice-President in charge of Sales is **Bill Adams** of the F. N. Adams Co. He will be assisted by **Rod McClellan** and **William Harrison.**

George Patterson has been added to the sales staff of The Miller Co., as sales representative for the Memphis territory, covering Memphis and Jackson, Tenn.; Paducah, Ky., and Little Rock, Ark. Mr. Patterson was formerly a supply salesman with Westinghouse Electric Supply Co. in Knoxville, Tenn.

Arthur J. Gambs, Jr., has joined Day-Brite Lighting, Inc. as Sales Promotion Manager. Mr. Gambs was formerly with Graybar Electric Co., in Cincinnati, as manager of inside construction sales.

Deaths

W. J. Bentley, Milwaukee Section.
Jules C. Berinstein, Chicago Section.
Byron B. Brown, Ohio Valley Section.
Earle D. Gilpin, Puget Sound Section.
William C. Matthews, Suwannee River Chapter.



Illuminating Engineering Society.

This is to certify that

F. H. Murphy

is a Member of the

Illuminating Engineering Society,

an organization for the advancement and dissemination of theoretical and practical knowledge of the Science and Art of Illumination.

Witness our hands and seal at New York this Thirteenth day of February 1906

NOT LISTED in the January issue of I.E. as a Charter Member, Professor F. H. Murphy, of the University of Portland, submits this copy of his membership certificate, dated February 13, 1906, and signed by I.E.S. first President, L. B. Marks. At that time Professor Murphy was teaching at Highland Park College, Des Moines, Iowa (later absorbed by Drake University) where he introduced one of the first courses in Illumination to be offered by a college in this country.

IT SEEMS TO ME

Thoughts of an R.V.P.

I have just returned from the 50th Anniversary National Technical Conference of the Illuminating Engineering Society, held in Boston this September. I would like to express some of the thoughts that go through the mind of a man who, while he may be a Regional Vice-President of the Society, is first and foremost a working field engineer who derives his livelihood from the lighting industry. And who is only an average member of the organization who happened to be elected to an official position in that organization.

Fellow members, I have spent long hours and years in working in the I.E.S. and I can truthfully say that every minute I have spent has given a measure of satisfaction which cannot be evaluated, for I felt that I was furthering the advancement of a science which affects the daily lives of all the people, possibly more than any other science we know.

But I have received tremendous benefits from this work and you can receive those same benefits. What are these personal benefits?

First, through my work in the Society, I have been able to travel these United States from the Atlantic to the Pacific and from Mexico to Canada. I have been in many cities which at one time were merely names on a map which I hoped I would some day see. I have had culture, enlightenment and broadening of the spiritual values imposed upon me. Through these I have achieved a profound feeling of solidarity with the people of every section of this land of ours.

Second, I have gained a close acquaintanceship with some of the most outstanding science and business leaders in the country today. How else could I achieve a close personal relationship with such persons as Ward Harrison, Dr. Bull, Dr. Wiseman, Dr. Domina Spencer, Charles Goddard, Sylvester Guth, John Neidhart, Phelps Mecker, Prof. Putnam, Dr. Lowry, Willard Allphin, Dan Finch, Everett Strong, Sam Hibben, Duncan Jones, Robert Hartenstein, Marshall Waterman, and many other leaders of industry and scientific thought? The information that I have received from these people, not only through the papers on which they report, but through the conversations I have had with them, has enabled me to carry on my work with a confidence in my own judgment which could be obtained in no other way.

Third, I hope you will not think me conceited when I say that through the Illuminating Engineering Society, I have received a measure of regard and respect in my own community and my own company as a man who knows the answers to many of these problems with which most people are unfamiliar. That, I owe completely to our Society, for without the wealth of information on theory and application which is available to every IES member and which comes to each and every member, I would not have the ability to solve those problems.

Perhaps some will think, "Here is a simple country boy in a small town who is impressed by the sights of the city." That is the exact truth. I am impressed. But I tell you that the work and personnel of the Society is worthy of the deepest respect of all of us who are interested in the advancement of our industry.

So I say to you as a fellow member of the Illuminating Engineering Society: the effort you expend in furthering the advancement of this organization will pay rich rewards. Do not consider yourself as merely a cog in a machine. I can assure you that the leaders of our Society

(*Continued on page 50A*)

When color helps you sell

this lightingware helps you sell color

Paints and Paisley prints, flowers and frocks and furniture, even foods—all sell best when your customers can see colors as they actually are.

And you can show color *in* your store as it appears in *natural* light with Corning Alba-Lite. *Engineered* Alba-Lite is not color-selective. Reds are not weakened. Deep colors show naturally. Alba-Lite doesn't alter the color of products with any tinge of its own.

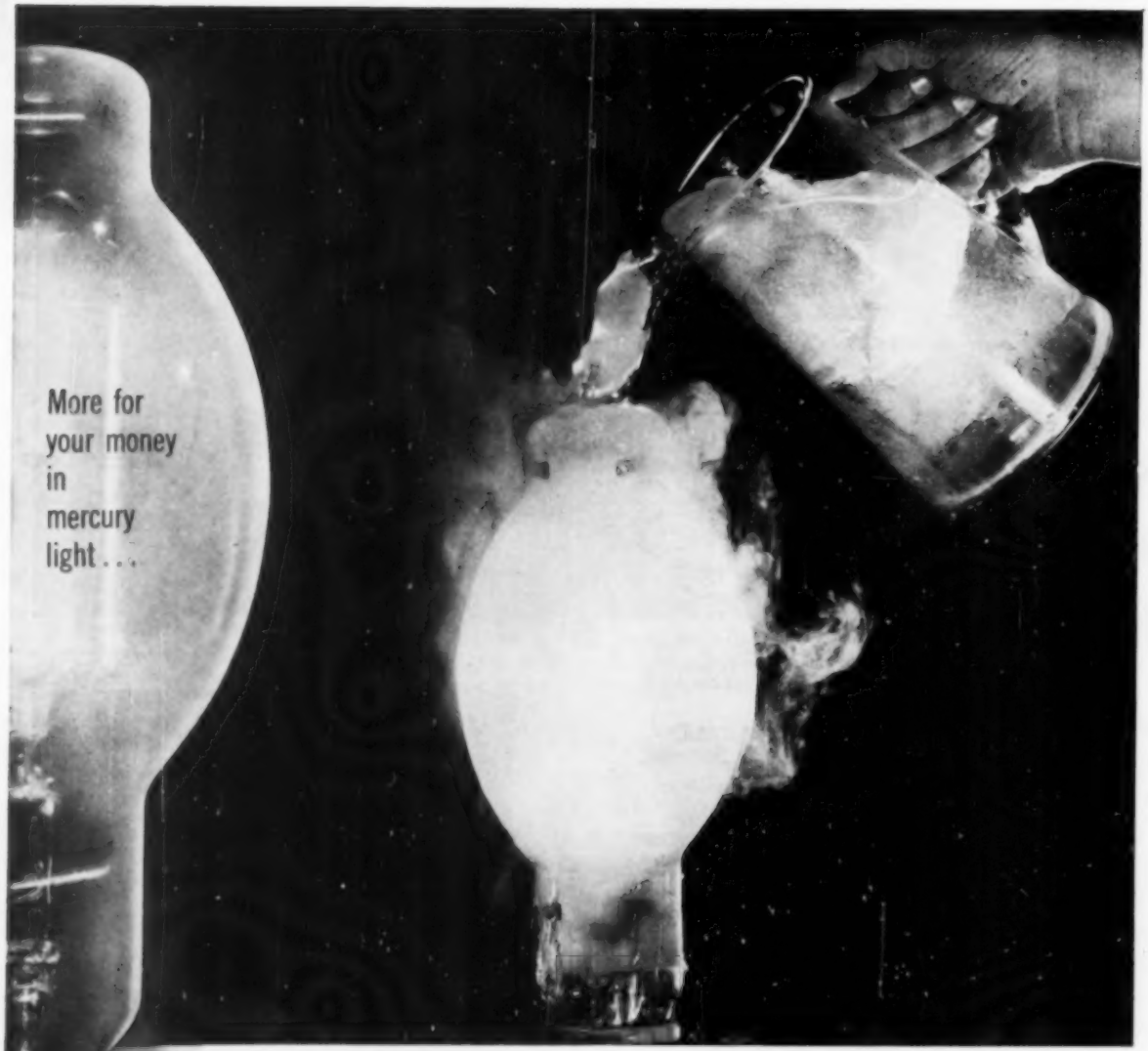
Besides the wonders it works in showing off color, Corning Alba-Lite gives your business place comfortably bright, glareless, shadowless illumination. Its smooth diffusion of light (a result of the composition of Alba-Lite) surrounds customers with even illumination.

You can use it rewardingly in full or partial luminous ceilings, and in individual fixtures. Alba-Lite is lightweight, never loses its light-transmitting qualities, doesn't sag, can't attract dust, is easy to maintain. And it's *not* at all expensive.

When you modernize your business place, build a new one (or if you just wonder what up-to-the-minute lighting can do for you) ask your architect, lighting engineer or your local utility about Corning Alba-Lite.

Corning means research in Glass

CORNING GLASS WORKS, 61-11 Crystal Street, Corning, N. Y.



ANNOUNCING NEW WESTINGHOUSE WEATHER DUTY(TM) MERCURY LAMPS

Down again go your lighting costs as Westinghouse announces another basic improvement in high-intensity mercury lamps. It's the world's first line of *weather-resistant*, heavy-duty mercury lamps.

Made with hard, tough, thermally stable glass, new Westinghouse WEATHER DUTY Mercury Lamps can be burned outdoors unprotected in rain, snow or sleet with no risk of cracking. And they can be burned indoors in ventilated fixtures with no danger of shattering under water drops entering through the ventilating openings. Moreover, they are highly resistant to mechanical breakage and to the corrosive effect of industrial fumes.

Thus in any type of installation—indoor or outdoor—Westinghouse WEATHER DUTY Mercury Lamps save you money three new ways. First, by eliminating the need for protective shields and permitting the use of cheaper fixtures. Second, by doing away with costly shield maintenance. And third, by releasing the large amount of light wasted by dirty shields.

WEATHER DUTY Mercury Lamps are the latest example of how Westinghouse gives you "*more for your money in mercury light.*" Now available types E-H1-WD, J-H1-WD, A-H12-WD, C-H12-WD, A-H15-WD and B-H15-WD.

WESTINGHOUSE GUARANTEES the service life of all its widely used types of quartz mercury lamps. For full details call your Westinghouse Lamp Representative—or write Westinghouse Lamp Div., Dept. IE-1, Bloomfield, N. J. "You can be sure if it's Westinghouse."

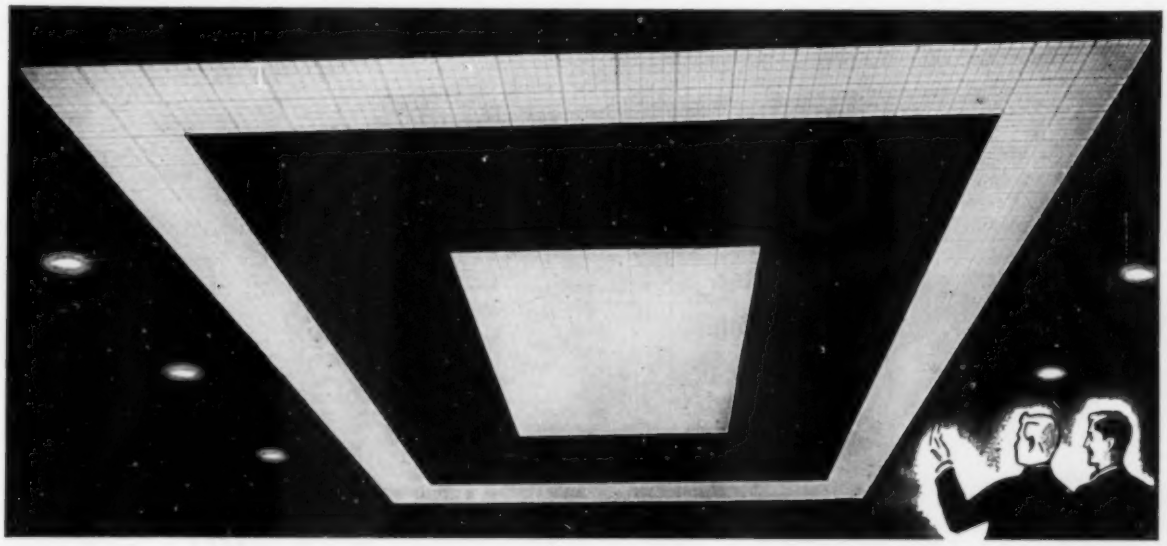
WATCH WESTINGHOUSE!

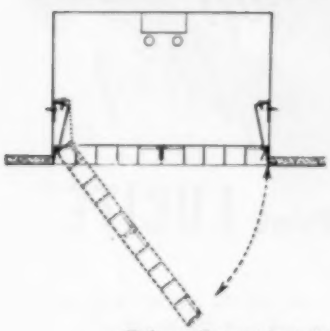
*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU***

There is a place for

Dramatic LUVE-TILE

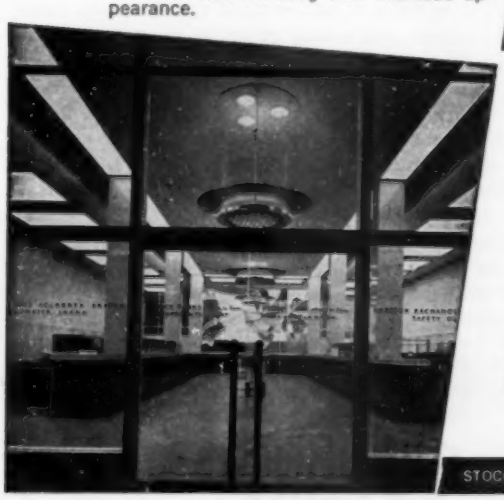
in every new building...or re-lighting job





- "**Luve-Tile**" can be hinged down from either side or completely removed for cleaning.
- Hinging arrangement also holds the "**Luve-Tile**" firmly in position. No bars or channels are necessary.

- Below—Recent installation of "**Luve-Tile**" demonstrates flexibility and dramatic appearance.



One-foot Square Louvred Panels Offer Practical, Creative Advances Over All Other Types —Particularly for Small Areas

Versatile — handsome — highly flexible, Luve-Tile is the delight of architects, illuminating engineers, contractors.

Designed by Wilson Engineers — manufactured under Wilson patents — it is (1) Easy to assemble to suit any area: no custom-made work necessary. No horizontal bars or rosettes required. (2) Easy to maintain — rigid, light in weight — easy to remove and wash. Dirt collection is retarded — does not hold insects, foreign matter. (3) Easy on the budget — Sprinklers and air ducts are concealed and wiring and other work may be simply surface mounted. Also low-cost acoustic material may be sprayed on the cavity above the tile for sound proofing. LUVE-TILE is practical and economical to use in any area, right down to a few square feet. It is also widely used in display for special effects.

Write for Luve-Tile Catalogue section No. 8.

"Engineered WILSON Seeing"

J. A. WILSON LIGHTING & DISPLAY INC.

260 DELAWARE AVE., BUFFALO 2, N.Y., PHONE MOhawk 5596

IN CANADA 280 LAKESHORE ROAD, TORONTO, ONTARIO

STOCKED AND DISTRIBUTED BY LEADING DISTRIBUTORS IN THE UNITED STATES & CANADA

Fixtures for the new National Housing Center, Washington, D.C., by Smithcraft Lighting Division, Chelsea, Massachusetts. LUCITE molded by Mack Molding Company, Arlington, Vermont. Architects: Aubinoe, Edwards and Beery, Washington, D.C. Lighting designed by Kluckhuhn, Cobb and McDavid, Washington, D.C. Electrical contractor: Walter Truland Company, Arlington, Va.

There are 381 fixtures, using 1,564 square feet of LUCITE, illuminating about 30% of the total floor space in the building. The LUCITE is installed in a single frame of steel hinged to the fixture. The Housing Center has an average of 45 foot-candles, as opposed to the 30 foot-candles usually found in office buildings.

Better looking, better lighting

with fixtures of Du Pont LUCITE®

The National Housing Center, in the heart of the nation's capital, is the show place of the home-building industry and the headquarters of the National Association of Home Builders. The eight-story, $2,500,000 building serves as a storehouse of accumulated knowledge on home building and related matters and a focal point for all major housing activities. Contributing to the beauty and efficiency of this modern architectural center are lighting fixtures made of LUCITE acrylic resin.

Fixtures of LUCITE are used on three floors, containing the offices, library, conference rooms and work areas. Because they are made of Du Pont LUCITE, these fixtures transmit optimum light without specular glare or shadow. They are strong, durable, free from discoloration and dimensionally stable. Installation is a simple matter.

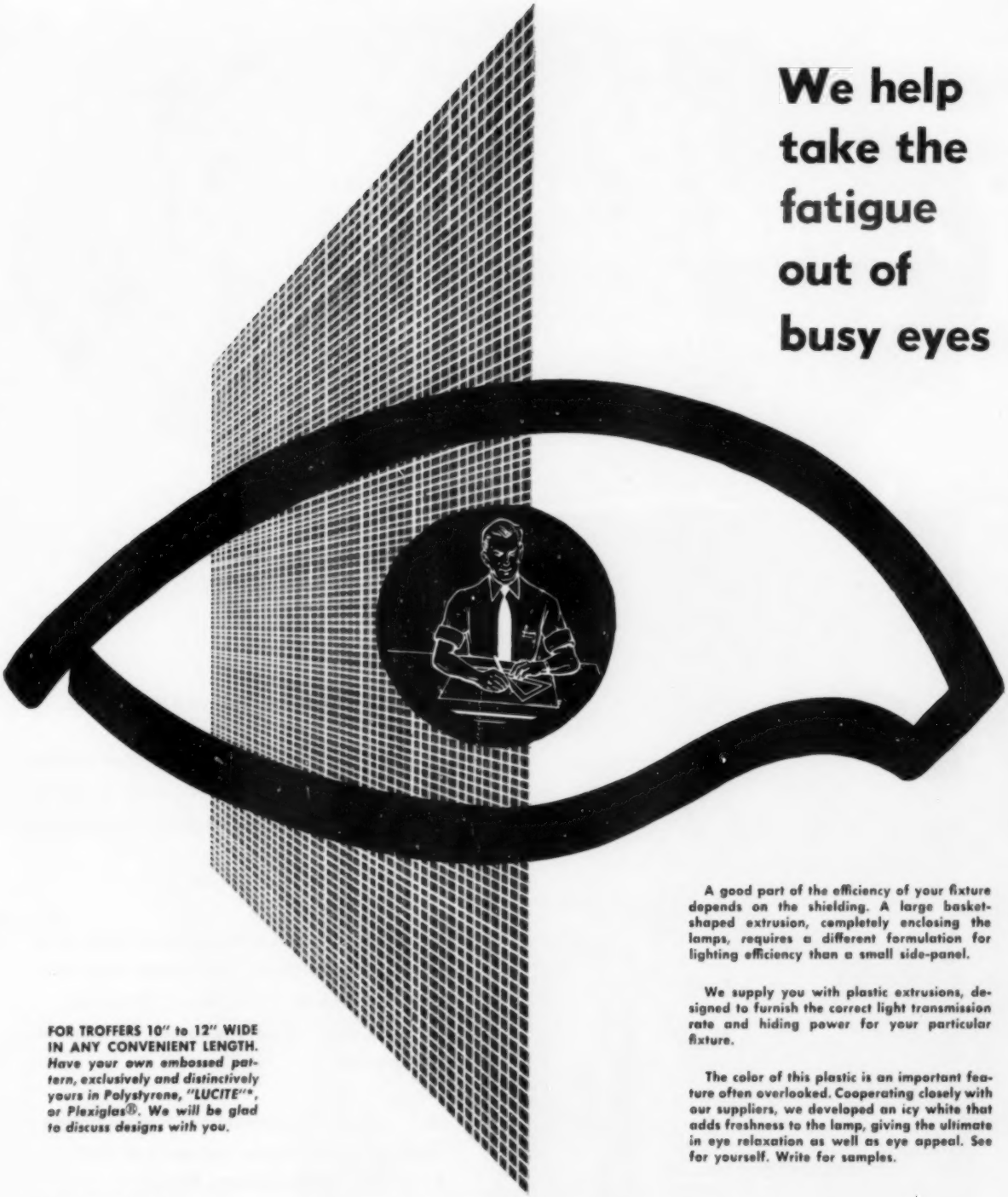
SEND FOR FREE, NEW BOOKLET. This new 12-page illustrated booklet describes all the latest property and application data on LUCITE acrylic resin for lighting. For your free copy, write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 2811, Du Pont Building, Wilmington 98, Delaware.

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

We help take the fatigue out of busy eyes



A good part of the efficiency of your fixture depends on the shielding. A large basket-shaped extrusion, completely enclosing the lamps, requires a different formulation for lighting efficiency than a small side-panel.

We supply you with plastic extrusions, designed to furnish the correct light transmission rate and hiding power for your particular fixture.

The color of this plastic is an important feature often overlooked. Cooperating closely with our suppliers, we developed an icy white that adds freshness to the lamp, giving the ultimate in eye relaxation as well as eye appeal. See for yourself. Write for samples.

FOR TROFFERS 10" to 12" WIDE IN ANY CONVENIENT LENGTH. *Have your own embossed pattern, exclusively and distinctively yours in Polystyrene, "LUCITE"*, or Plexiglas®. We will be glad to discuss designs with you.*

*DuPont Trade Mark

For fast dependable service, economical, too . . . ring for

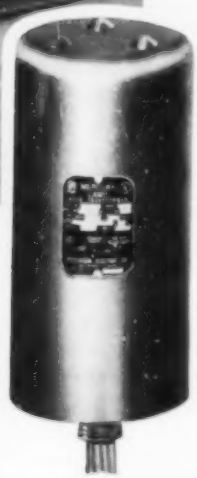
ROTUBA EXTRUDERS, INC.
418 88th STREET • BROOKLYN 9, NEW YORK
SHore Road 8-5458

Makers of
PANELS • SHIELDS • DIFFUSERS IN PLASTICS

Phila. Office
R. L. BOUSE, FLOURTOWN, PENNA.
Tel. CHESTNUT HILL 8-1010

NEW JEFFERSON 2-LAMP

Outdoor Mercury Lamp Transformer for 400 Watt H-1 Lamps



- Lag-Lag 300 Volt Open Circuit Design *for reliable cold weather starting.*
- High Power Factor.
- Accommodates *all* 400 Watt H-1 Lamps.
- Failure of one lamp does not affect the life or operation of the second lamp, or cause damage to this new Jefferson Transformer.
- Pole Base Mounting.
- Similar two lamp units are available with wiring compartments for aerial, wall and pole-top installations. Newly designed brackets and pole-top adapter are optional equipment.
- Weatherproof Construction: Heavy gauge steel case hot dipped galvanized and finished with Dura Gray Paint.

DIMENSIONS

Diameter 7½"
Height of Case 14¾"
Overall Height 16"

For further details contact your nearby Jefferson Representative.

Jefferson Electric Company

BELLWOOD, ILLINOIS

new dimension . . .

in fixture value with THE *new* SMITHCRAFT FINISH

Smithcraft now adds a new dimension in fixture perfection. The new Smithcraft painting process consists of the finest and most modern Bonderite and Baked Enamel Finish combination in use in the lighting industry today.

In addition to its superior appearance, the new Smithcraft finish has these outstanding qualities:

Adheres firmly to metal — Stays white indefinitely, without yellowing — Provides positive resistance to chemicals and heat — Resists abrasion because of optimum hardness — Reflects a maximum percentage of light

Because the new Smithcraft finish possesses all these attributes to a greater degree than ordinary finishes, it produces many important new benefits for owners and users of lighting . . . better appearance, better lighting qualities, easier maintenance and longer, trouble-free life.

All the units in the complete and diversified line of Smithcraft commercial and industrial fixtures are now finished with this new process. Typical is the Sheraton (shown above) . . . a trim, modern unit, only 3¼" deep; the Sheraton is ideal for low-ceiling applications. It is available for two and four-lamps in 4-ft. and 8-ft. lengths. Plan to use the Sheraton in your next school, store or office design.

Ask us to send you the current Smithcraft catalog . . . it is a compilation of the newest and most functional fluorescent fixtures in use today

Smithcraft
LIGHTING
CHELSEA 50, MASSACHUSETTS

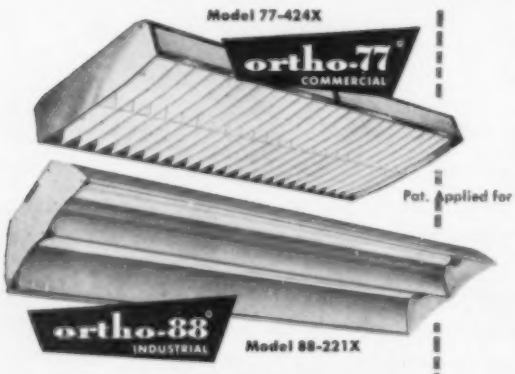
America's finest fluorescent lighting

1 Telescoping sections of UNI-RACE assembled and wired on the floor.

2 UNI-RACE, in 24' to 48' assemblies, can be hung from bar joists, I-beams or stems.

3 Fixtures snapped into place in seconds without tools.

HERE'S BETTER LIGHTING AT HALF THE COST



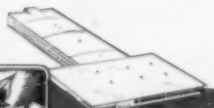
FEATURES THAT DEFY COMPARISON

- **ON-JOB POWER SOURCE** Before fixtures are installed, receptacles in UNI-RACE provide power source for tools and temporary lighting.
- **NO FIXTURE STORAGE** Fixtures need not be delivered until premises are painted. The units can then be snapped into place—clean and factory fresh.
- **VARIABLE SPACING** Fixtures can be mounted in continuous rows or at intervals of 4, 8, 12 or more feet—added, removed or respaced at any time.

The Gibson ORTHO Fixture is a completely new concept in commercial and industrial lighting design. The exclusive UNI-RACE, shipped separately from the fixtures, provides straight alignment, exact fixture spacing and a fixed power source (receptacle) for each fixture. It banishes those pesky aligning problems and eliminates all electrical work on the fixture itself—just take the units as they come from the box and snap into place at any desired interval of 4′ or 8′ on the UNI-RACE.

All of which adds up to a 50-percent saving in labor and material—often more—unheard of flexibility to the user, and gives you a better-looking, higher-quality job.

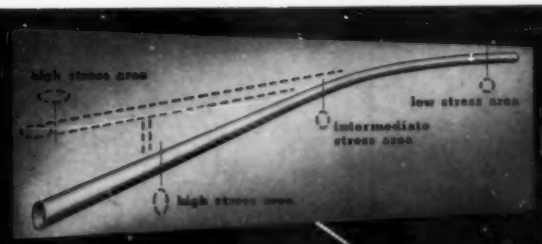
There are many other advantages you ought to know about. Drop us a line today, we'll gladly send you complete information about the remarkable new ORTHO-77 and 88 for commercial and industrial applications.



Gibson LIGHTING

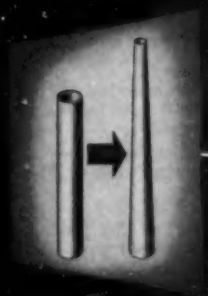
GIBSON Manufacturing Co.

1919 Piedmont Circle, N.E., Trinity 3-8447, Atlanta 9, Georgia



FIRST to provide ample strength in all-aluminum arms and arm-shaft joints through patented, seamless elliptical arms requiring no bracing for lengths up to 8 feet. On longer arms, one horizontally elliptical member, integrally welded to the arm, eliminates need for side-sway bracing.

FIRST to develop fabricating equipment and methods to permit use of high strength aluminum alloys.



FIRST to develop and produce seamless, tapered shafts from high-strength, extruded tubing in a wide range of diameters.

FIRST to pioneer the Aircomatic method of welding for fast, strong welds and negligible deterioration of alloy strength. All P & K welds are guaranteed . . . all P & K welding personnel and equipment is certified by U. S. Government agencies.

FIRST to stress use of castings of heat-treatable aluminum alloy, and first to introduce permanent mold castings for transformer bases, shoe and pedestal bases . . . with smooth surfaces and strong grain structure.

FIRST to eliminate unnecessary scrolls, tie-rods and other ornamental frills.

FIRST to design and build its own tapering machine to handle all diameters of extruded aluminum tubing.

Seven firsts . . . . . All are P&K

P & K . . . Producer of America's Most Modern All-Aluminum Standards and Brackets FOR LIGHTING TRAFFIC SIGNAL POSTS — TRAFFIC AND COMMERCIAL SIGN POSTS

SEVEN P & K FIRSTS! They add up to this: P & K All-Aluminum Standards, Arms and Posts do the job better, easier and at far less cost than any other "pole" of any other material or design.

WRITE FOR THE NEW P & K CATALOG . . . and use the planning and advisory services without obligation.

Pfaff & Kendall

84 Foundry Street
Newark 5, New Jersey

design by mc Philben

An Exterior Wall Bracket—4-50

Here's durability and performance . . . in a distinctive modern design

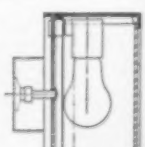
Striking in its simplicity . . . designed for long-lasting, all-weather protection . . . maximum efficiency, wherever lighting fixtures take a beating.

IT'S MADE OF heavy die-cast aluminum throughout . . . satin-finished . . . anodized for protection against sun, rain, dampness.

THE UNIT INCLUDES a medium base twin porcelain lamp holder for one 150-Watt inside-frosted lamp and Flutex curved glass diffusers. The assembly is simple . . . a hinged door frame secured to a back plate with a captive held screw.

APPLICATIONS COVER . . . schools, hospitals, libraries, railway and bus stations, factories, public and office buildings . . . all institutions!

FOR OTHER WALL BRACKETS in exterior line, write for data on . . . the "4 line". **DIMENSIONS**—(4-50) 8" high, 11" wide, with a 4¾" projection from the wall.



1353 Willoughby Ave., Brooklyn 37, N. Y.

CONSULT mcPhilben Lighting SPECIFY

Representatives in major cities
Stocked By Electrical Wholesalers

(Continued from page 40A)

and the persons whom I have previously mentioned are just as cognizant of the importance of the work of individual members as we are of theirs. It is only through the efforts of the individual member that we can continue to expand and grow as a dynamic force in an industry which can do as much or more than any other to add to the growth of the stature of our respective countries.

I urge that each and every one of you, as members of an illustrious Society, consider seriously what I have said. Work hard in your chapter or section. In return, you will receive inspiration, guidance and recognition. You too can take your place in line with those many others who can rightfully say, "I have made a contribution to the general advancement of our industry and to the enlightenment of the people in a whole world." — J. D. WHITNELL, *Arizona Public Service Co., Phoenix, Ariz., and Vice-President, Inter-Mountain Region, I.E.S.*

BOOKS AND PAMPHLETS

Common Sense in School Lighting, published by the American Association of School Administrators, 1201 Sixteenth St., N. W., Washington 6, D. C. 24 5½ x 7½ pages. 50 cents.

Directed at school administrators and superintendents, this booklet discusses various aspects of school lighting — daylighting and electric lighting — including brightness controls and surface reflectances as part of the visual environment.

Church Lighting, reprinted from *Light and Lighting*, June 1956 issue, published by the Illuminating Engineering Publishing Co. Ltd., 32 Victoria St., London, S.W.1. 2/6d including postage.

This reprint from a church lighting "special" of the British I.E.S. magazine illustrates and describes installations not only in Great Britain, but also in other European countries.

Careers for Engineers in Illinois, Michigan and Wisconsin, published by the United States Civil Service Commission, Seventh Region, Chicago 7, Ill.

Jobs for engineers, with and without professional experience, in the area named are described as to requirements, duties, salaries for GS-5 through GS-15.

Your Eyes After Forty, published by the National Society for the Prevention of Blindness, 1790 Broadway, New York 19, N. Y. 6 pages. Single copies upon

(Continued on page 52A)

Certified Lighting for a Better America

ELECTRICAL CONTRACTORS, WHOLESALERS, LIGHT & POWER COMPANIES!

This program is sponsored by all these member companies of the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association to help you increase your sales.

These manufacturers stand ready collectively and individually to cooperate with you in every possible way to help you get the most out of this CERTIFIED LIGHTING PROGRAM. Call on them!

Abolite Lighting Division
The Jones Metal Products Co.
Amplex Corp.
Benjamin Electric Mfg. Co.
M. Black Mfg. Co.
Columbia Electric & Mfg. Co.
Compco Corp.
Curtis Lighting, Inc.
Day-Brite Lighting, Inc.
Eastern Fixture Co.
Fluores-O-Lite Co.
The Frink Corp.
Fullerton Mfg. Corp.
Garden City Plating & Mfg. Co.
General Lighting Products Co.
Great Northern Mfg. Corp.
The Edwin F. Guth Co.
Holdenline Co.
Holophane Co., Inc.
The Kirlin Co.
Lighting Products, Inc.
Litecontrol Corp.
Markstone Mfg. Co.
The Metalcraft Products Co., Inc.
The Miller Co.
Morlite Equipment Co.
Overbagh & Ayres Mfg. Co.
Pittsburgh Reflector Co.
The Pyle-National Co.
Quadrangle Mfg. Co.
Ruby-Phillite Corp.
Silvray Lighting, Inc.
Smithcraft Lighting Division
A. L. Smith Iron Co.
Smoot-Holman Co.
Solar Light Mfg. Co.
The Spero Electric Corp.
Sun-Lite Mfg. Co.
Sylvania Electric Products, Inc.
Kurt Versen Co.
The Wakefield Co.
Westinghouse Electric Corp.
Wheeler Reflector Co.
R. & W. Wiley, Inc.
The Wiremold Co.

New... Easier Way to Sell Bigger Profit Lighting Jobs!

Guarantee Satisfaction By Having Your Lighting Plan Certified to Meet NATIONAL STANDARDS

Now you can get the 3 business-clinching sales tools you've always wished you had to sell more lighting jobs! (1) Now you've got a tested way to prove to customers that you can and will deliver the kind of lighting they need. You've got a CERTIFIED Lighting Plan to back you up. It's the best way yet developed to keep customers from being tempted into buying sub-standard jobs because of price! (2) You've got the PLUS FEATURES Check List to sell MORE QUALITY into the job and get a bigger order, too! (3) You've the certificate issued by a disinterested authority countersigned by you, to back up your selling of proper illumination. Get all the facts... write for free booklet.

Is Certified Lighting In Operation in Your Area?

This program is operated locally under the joint sponsorship of all electrical groups. If your area is listed below, get in touch with your local group... otherwise, write The National Lighting Bureau.

Boston, Mass.
Charlotte, N. C.
Chattanooga, Tenn.
Cincinnati, Ohio
Detroit, Mich.
Jackson, Miss.
Los Angeles, Cal.
New Orleans, La.
Norwalk, Conn.
Omaha, Neb.
Providence, R. I.
Rochester, N. Y.
Sacramento, Cal.
San Diego, Cal.
San Francisco, Cal.
Spokane, Wash.
Waterbury, Conn.
Worcester, Mass.

Certified Lighting for a Better America

R-1192R

Copyright 1956, National Lighting Bureau

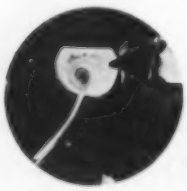
Certified Lighting

NATIONAL LIGHTING BUREAU, 155 East 44th Street, New York City. Sponsored by the Industrial and Commercial Lighting Equipment Section of NEMA the National Electrical Manufacturers Association

Ask these questions, too, when you judge a fluorescent lamp...

Is your investment protected?

Check Westinghouse Fluorescent Lamps against any other brands you are now using. Check them for maintained brightness, long life, uniform appearance. If you are not entirely satisfied on all counts, your full purchase price will be refunded.



Is it built with tailored glass?

Quality of glass in a fluorescent lamp directly affects lamp performance. Westinghouse makes all of its own fluorescent lamp glass, tailoring it from silica to finished tubing specifically for fluorescent service.

Is it the correct type, size and color for the lighting job to be done?

In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and merchandising application. Colors include seven different shades of "white" alone.

For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp Representative.

WATCH WESTINGHOUSE

WHERE BIG THINGS ARE HAPPENING FOR YOU!

(*Continued from page 50A*)

request. This brochure, a feature of "Sight-Saving Month" of this organization, traces the changes which take place in the eyes during the second half of life, including normal developments and diseases.

Office and Drafting Room Lighting Solutions, LS-145R; **Lighting for Show Windows and Open-Front Stores,** LS-158; **Fluorescent Lamps and Auxiliary Equipments,** LS-101; **Mercury Lamps and Transformers,** LS-103. Available from General Electric Co., Nela Park, Cleveland, Ohio.

Footcandle Levels and Interior Design Data, Booklet A-4854, available from Westinghouse Electric Corp., Bloomfield, N. J.

A Study of the Thermal Aspects of the Lighting System, Part I—Its Relation to the Cooling Load, published by the American Society of Heating and Air-conditioning Engineers, 62 Worth St., New York 13, N. Y. 31 pages in multilith. Single copy price, 75 cents.

This brochure brings together the two sections of the report by the Joint I.E.S.-A.S.H.A.E. Committee. The first section, answers to questions on light sources and lighting practice, is, for the most part, based on the I.E.S. Light Sources Committee's Question and Answer page in I.E. and the lamp data in the *I.E.S. Lighting Handbook*. The second section, of questions on cooling systems answered by the airconditioning engineers, was published in the September issue of ILLUMINATING ENGINEERING.

NEW MEMBERS

At the meeting of the I.E.S. Council Executive Committee, held at New York, N. Y., on October 11, 1956, the following were elected to membership. Names marked * are transfers from Associate Member grade.

ARIZONA SECTION

Associate Members:
McKenzie, D. J., Arizona Public Service Co., Yuma, Ariz.
Wuertemburg, P. J., Arizona Public Service Co., Yuma, Ariz.

ARK-LA-TEX CHAPTER

Associate Members:
Kiper, Ralph, Inn Hotel Building, P. O. Box 26, Shreveport, La.
Moorman, Jack, Jack Moorman Electric Co., Shreveport, La.

BRITISH COLUMBIA SECTION

Associate Members:
Bradfield, T. A., Canadian Westinghouse Supply Co. Ltd., Vancouver, B. C.
Matthias, A. E., 1819 Dunbar St., Vancouver, B. C.

CENTRAL ILLINOIS CHAPTER

Associate Member:
Larson, Donna M., May Electric Supply Co., Kewanee, Ill.

CENTRAL NEW YORK SECTION

Associate Member:
Morgan, J. H., N. Y. State Electric & Gas Co., Elmira, N. Y.

CENTRAL OKLAHOMA CHAPTER

Member:
*Davis, C. E., Davis & Robinson, Oklahoma City, Okla.

CHICAGO SECTION

Associate Members:
Biester, R. E., Curtis Lighting Inc., Chicago, Ill.
Cohen, Melvin, A. Epstein & Sons, Chicago, Ill.
Grant J. P., General Electric Co., Danville, Ill.
Harris, E. W., Curtis Lighting Inc., Chicago, Ill.
Hellickson, D. E., Curtis Lighting Inc., Chicago, Ill.
Howland, E. K., Leonhardt-Howland Advertising Agency, Chicago, Ill.
Leonhardt, R. E., Leonhardt-Howland Advertising Agency, Chicago, Ill.
Massman, C. E., Sylvania Electric Products Inc., Melrose Park, Ill.
McCreight, M. E., Lighting Products Inc., Highland Park, Ill.
Meecher, W. C., Public Service Co., Glencoe, Ill.
O'Connell, P. J., Kempner O'Connell & Assoc. Inc., Chicago, Ill.
Rogoza, Leonard, Vern E. Alden, Chicago, Ill.
Sanders, Kerr, Jr., Chicago Lighting Institute, Chicago, Ill.
Tomaszkiewicz, R. J., Curtis Lighting Inc., Chicago, Ill.

CHINOOK CHAPTER

Associate Members:
Lawrence, Walter, Electrical Contracting & Machinery Ltd., Calgary, Alta.
Longmate, A. W., Grover & Longmate, Calgary, Alta.
Martin, W. M., Fluorescent Sales & Service, Calgary, Alta.
McKenzie, Jack, Amalgamated Electric Corp., Calgary, Alta.
Noble, G. T., Blackwell Electric, Calgary, Alta.
Stancer, O. G., Stancer Electric & Appliances, Calgary, Alta.
Venable, R. E., Canadian General Electric Co. Ltd., Calgary, Alta.
Warrack, William, Warrack Electric, Calgary, Alta.

CLEVELAND SECTION

Member:
Kauffman, V. C., General Electric Co., Nela Park, Cleveland, Ohio.
Associate Members:
Carle, R. L., The Thompson Electric Co., Cleveland, Ohio.
Flynn, J. E., General Electric Co., Cleveland, Ohio.
Jankowski, J. A., General Electric Co., Cleveland, Ohio.
Kershaw, Delmar, General Electric Co., Cleveland, Ohio.
Makulec, Alfred, General Electric Co., Cleveland, Ohio.
Newman, H. E., Westinghouse Electric Corp., Cleveland, Ohio.
Steichen, A. J., Sola Electric Co., Cleveland, Ohio.
Student Member:
Paugh, R. L., General Electric Co., Cleveland, Ohio.

CONNECTICUT SECTION

Members:
*Young, H. R., Litecontrol Corp., Watertown, Mass.

(*Continued on page 55A*)

how to judge a fluorescent lamp . . . point no. 9

ask about **ELECTRODE QUALITY**

Better electrodes in a fluorescent lamp mean *longer lamp life*. That's why Westinghouse cuts no corners in its electrode manufacture. All Westinghouse electrode coil wire, for example, is drawn through diamond dies. Some of it has to be drawn so fine that a single pound will extend from New York to Pittsburgh. Thanks to constant development of new and better ways to make fluorescent lamp electrodes, Westinghouse has *tripled* the life of its fluorescent lamps since 1948.

WATCH WESTINGHOUSE
*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

How well-lighted streets make life brighter for everyone

Who benefits when you modernize street lighting?

Safety Officials?

If darkness is the culprit that causes two-thirds of the nation's fatal accidents, what happens when light chases dark? In one study, an area experienced a drop in nighttime fatalities from 34 to only 3 following street lighting modernization. So lighting helps safety directors and their staffs achieve their goals.

Law Enforcement Officials?

Tests show that brilliant illumination quickly cuts crime rates in trouble areas. Light makes burglary, muggings and assaults a lot less attractive to criminals who count on the dark of night to help them escape. And light helps make life safer for law enforcement officers.

Businessmen?

Bright, well-lighted streets attract people, encourage night buying. And night buying is increasingly important to retailers. Obviously, the businessman benefits from good street lighting.

Citizens?

The taxpayer who pays the bill for modern street lighting gets a rare bargain in safety when he walks and drives. He gets protection for his family and his home because light discourages criminals.

Everyone's life is better and safer, often more prosperous because of modern street lighting. It's an investment your city can't afford *not* to make.

Street light equipment manufacturers will be glad to show you how modern lighting can make your city brighter and better.

Modern street light design makes the most effective use of lighting dollars.

Corning lens designers are working constantly to improve light control.

CORNING GLASS WORKS, CORNING, N. Y.
34-11 Crystal Street

Corning means research in Glass

(Continued from page 52A)

Associate Members:
Masarjian, A. E., Morton Sable & Co., Brookline, Mass.
Mathews, N. S., The Miller Co., Meriden, Conn.
Richardson, W. E., Hilton Hotels, New York, N. Y.
Vous, E. G., The Miller Co., Meriden, Conn.

CORNHUSKER CHAPTER

Associate Member:
Nyreen, C. W., Nystrom Electric Co., Sioux City, Iowa.

EASTERN NEW YORK SECTION

Associate Member:
Lesnevshy, A. F., General Cable Corp., Syracuse, N. Y.

FLORIDA SECTION

Associate Members:
Day, Emerson, EDCO, 1946 Caesar Way S., St. Petersburg, Fla.
Glaser, W. A., Appleton Electric Co., Clearwater, Fla.

FOREIGN NON-SECTION

Members:
Ikeda, E., The Nissho Electric Co. Ltd., Minato-ku, Tokyo, Japan.
Associate Members:
Ackerman, K. R., British Broadcasting Corp., London W 1, England.
Alm, L. O., Gustav Magnussons Konsulterande Ingernior, Stockholm, Sweden.
Luis Torres, P. W., Electro Sales Co. Ing., Havana, Cuba.
Maxia, Alfonso, Via Mario Pagano 50, Milano, Italy.
Mogford, G. S. H., Crompton Parkinson Ltd., Wheatley Doncaster, Yorks, England.
Rajagopaliengar, B. S., Indian Institute of Technology, Kharagpur (West Bengal), India.
Torres Ruiz, J. G., Circuito CMQ, S. A., Havana Vedado, Cuba.

GEORGIA SECTION

Associate Members:
Buchanan, W. W., Georgia Power Co., Atlanta, Ga.
Humphrey, D. K., Georgia Power Co., Atlanta, Ga.

GOLDEN GATE SECTION

Associate Members:
Jones, W. A., Soland County, P. O. Box 1127, Fairfield, Calif.
Slavsky, Joe., 505 Van Ness Ave., San Francisco, Calif.
Student Member:
Hatfield, David, 1335 Oak, San Bernardino, Calif.

HEART OF AMERICA SECTION

Member:
*Harper, G. G., General Electric Co., N. Kansas City, Mo.
Associate Members:
Kesler, J. P., Black & Veatch, Kansas City, Mo.
Lait, H. H., General Electric Co., Kansas City, Mo.

INDIANA SECTION

Associate Member:
Dickinson, E. R., H. L. Dickinson, Indianapolis, Ind.

INLAND EMPIRE CHAPTER

Associate Member:
Rookey, R. D., Washington Water & Power Co., Spokane, Wash.

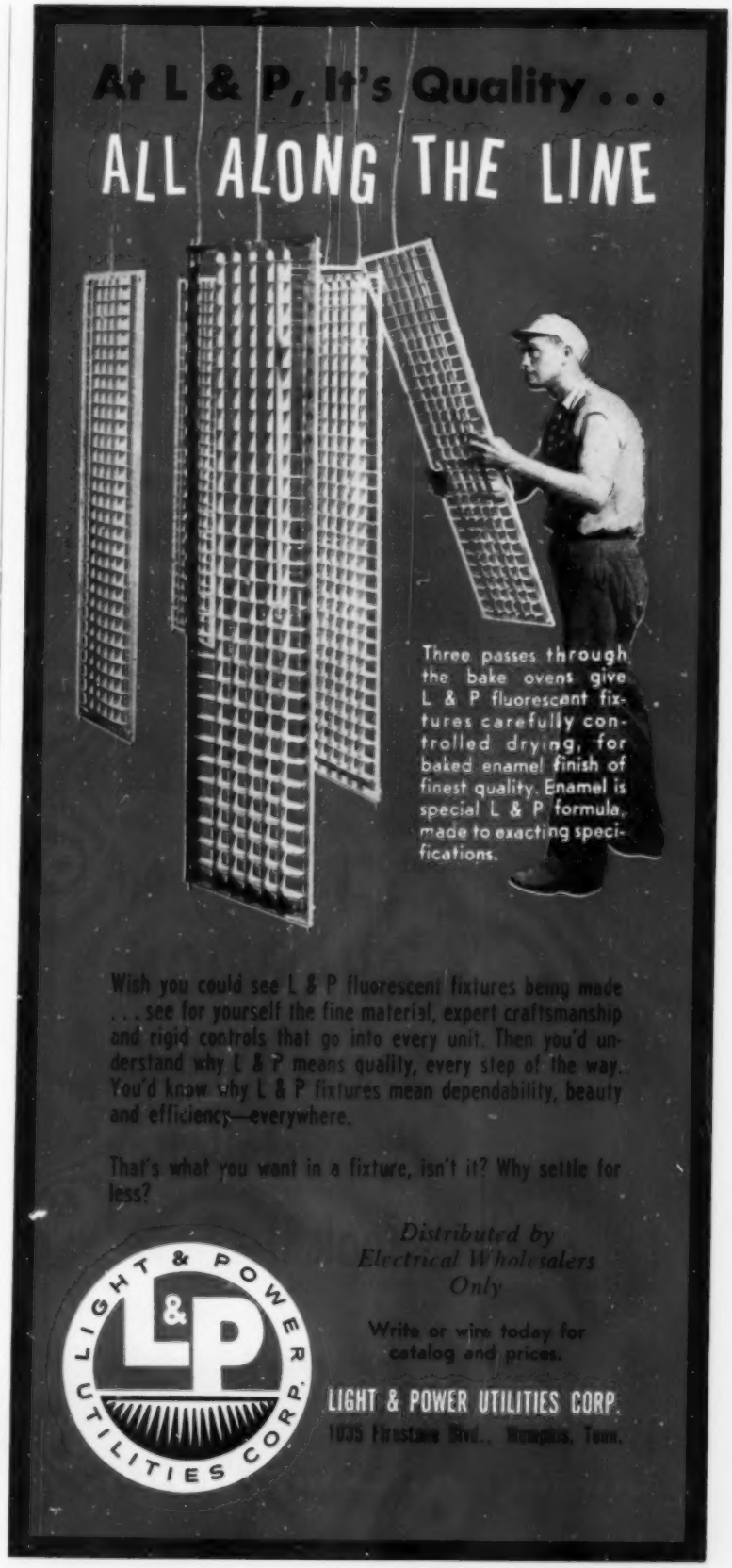
IOWA SECTION

Associate Members:
Oja, Arne, George C. Mittauer & Assoc., Cedar Rapids, Iowa.
Slattery, R. J., The Miller Co., Meriden, Conn.

MARITIME CHAPTER

Associate Member:
Welsh, G. C., G. Keith Pickard, Summerside, P.E.I., Canada.

(Continued on page 56A)


At L & P, It's Quality . . .
ALL ALONG THE LINE
Three passes through the bake ovens give L & P fluorescent fixtures carefully controlled drying, for baked enamel finish of finest quality. Enamel is special L & P formula, made to exacting specifications.
Wish you could see L & P fluorescent fixtures being made . . . see for yourself the fine material, expert craftsmanship and rigid controls that go into every unit. Then you'd understand why L & P means quality, every step of the way. You'd know why L & P fixtures mean dependability, beauty and efficiency—everywhere.
That's what you want in a fixture, isn't it? Why settle for less?
Distributed by Electrical Wholesalers Only
Write or wire today for catalog and prices.
LIGHT & POWER UTILITIES CORP.
LIGHT & POWER UTILITIES CORP.

(*Continued from page 55A*)

MARYLAND SECTION

Associate Member:
Ludwig, Joseph, Jr., Champion Lamp Works, Lynn, Mass.

MEXICO CHAPTER

Associate Members:
Bernal, L., Equipos y Materiales Electricos, Mexico, D. F.
Melo Paz, Enrique, "Guerrero Hnos," Mexico, D. F.

MID-SOUTH CHAPTER

Student Members:
Beckum, J. T., Southern College of Optometry, Memphis, Tenn.
Flippin, H. F., Southern College of Optometry, Memphis, Tenn.
Harmon, K. R., Southern College of Optometry, Memphis, Tenn.
Harris, S. L., Southern College of Optometry, Memphis, Tenn.
Johnston, C. E., Southern College of Optometry, Memphis, Tenn.
Monsour, George, Southern College of Optometry, Memphis, Tenn.
Rimmer, L. W., Southern College of Optometry, Memphis, Tenn.
Shields, William, Southern College of Optometry, Memphis, Tenn.

MILWAUKEE SECTION

Associate Member:
Daniels, Stephen, Northern Light Co., Milwaukee, Wis.

MONTREAL SECTION

Associate Members:
Archambault, Gilles, 1883, St. Marc St., Shawinigan Falls, Que.
Aubin, Florian, Canadian Westinghouse Supply Co., Trois Rivieres, Que.
Blouin, Maurice, Blouin & Lefrancois Inc., Trois Rivieres, Que.
Bornais, Marcel, Ecole Technique des Trois Rivieres, Trois Rivieres, Que.
Deniger, L. R., The Shawinigan Water & Power Co., Shawinigan Falls, Que.
Ducharme, Lucien, 1031 Ste. Julie St., Trois Rivieres, Que.
Gailloux, J. P., Northern Electric Co., Trois Rivieres, Que.
Gauthier, J. P., P. A. Gouin, Ltee, Trois Rivieres, Que.
Gendron, Paul, P. A. Gouin, Ltee., Trois Rivieres, Que.
Girard, M. Cecilio, Eusebe Girard, Trois Rivieres, Que.
Guilbert, Gaston, Canadian General Electric Co., Trois Rivieres, Que.
Heroux, F., The Shawinigan Water & Power Co., Trois Rivieres, Que.
Lafreniere, Nelson, Lucien Ducharme Engrg., Trois Rivieres, Que.
Lamothe, C. E., C. E. Lamothe Incorpore, Trois Rivieres, Que.
Richard, Lucien, Canadian General Electric Co., Trois Rivieres, Que.
Saulniers, J. R., 14 Rocheleau St., Cap de la Madeleine, Que.
Sirois, Georges, Canadian General Electric Co., Trois Rivieres, Que.
Todd, Alex, Northern Electric Co., Trois Rivieres, Que.

MOTHER LODE CHAPTER

Associate Member:
Jeung, A. M., 728 N. Ophir St., Stockton, Calif.

NEW ENGLAND SECTION

Members:
Baker, S. L., P. O. Box 75, Whitman, Mass.
Coggins, D. L., Sylvania Electric Products Inc., Salem, Mass.
*Eichorn, J. F. G., Jr., Suburban Electric Co., Malden, Mass.
Associate Members:
Cheney, H. V., 533 Main, Melrose, Mass.
Mass, D. L., Magni Flood Inc., Brookline, Mass.
McIsaac, K. F., Neo-Ray Lighting Products, Quincy, Mass.

Rudolph, George, Lighting Maintenance Co., Chelsea, Mass.
Sauvageau, G. E., E. J. Sauvageau & Son, Inc., Woonsocket, R. I.
Somes, D. W., Graybar Electric Co. Inc., Boston, Mass.

NEW ORLEANS SECTION

Associate Members:
Goodgame, C. S., Central Louisiana Electric Co. Inc., Covington, La.
Hart, R. A., III, 1742 N. 21st St., Baton Rouge, La.

NEW YORK SECTION

Members:
Miller, H. J., Day-Brite Lighting Inc., New York, N. Y.
Rainone, N. J., Westinghouse Electric Corp., Bloomfield, N. J.
Associate Members:
Andreasen, G. C., Westinghouse Electric Corp., Bloomfield, N. J.
Archer, F. R., Sylvania Electric Products Inc., Teterboro, N. J.
Atkin, Leonard, Stonco Electric Products Co., Kenilworth, N. J.
Cantin, R. A., Westinghouse Electric Corp., Bloomfield, N. J.
Cone, Robert, Rambusch Decorating Co., New York, N. Y.
Dille, Gordon, William Esty Co., New York, N. Y.
Eason, C. N., Westinghouse International Co., New York, N. Y.
Fowler, W. T., Corning Glass Works, New York, N. Y.
Germaine, Milton, Luminous Ceilings Inc., New York, N. Y.
Hoffman, J. C., Westinghouse Electric Corp., Bloomfield, N. J.
Koechel, A. J., Corning Glass Works, New York, N. Y.
Kuehne, Richard, Lovell Dressel Co., Arlington, N. J.
Martenson, R. B., Sylvania Electric Products Inc., New York, N. Y.
McKenna, H. J., American Gas & Electric Service Corp., New York, N. Y.

NORTHWESTERN OHIO SECTION

Members:
*Brigham, E. R., Sanzenbacher, Miller & Brigham, Toledo, Ohio.
*Colgan, R. W., Rogers Electrical Service Inc., Toledo, Ohio.

OHIO VALLEY SECTION

Associate Member:
Ostrander, D. T., 1435 Collinsdale St., Cincinnati, Ohio.

OTTAWA SECTION

Member:
Brown, T. L., 588 Pleasant Park Road, Ottawa, Ont.

PALMETTO CHAPTER

Member:
Burrell, P. D., 105½ W. Main St., Spartanburg, S. C.
Associate Member:
Melton, C. T., Utilities Construction Co., Charleston, S. C.

PITTSBURGH SECTION

Associate Members:
Casto, H. J., Casto Electric Co. Inc., Fairmont, W. Va.
Hunt, R. W., Ohio Power Co., Steubenville, Ohio.
Miller, H. T., Jr., Electrical Service Co., Brownsville, Pa.
O'Brien, J. R., 4116 Beech, Erie, Pa.
Rulli, Anthony, City Electric Co., Connellsville, Pa.

PUGET SOUND SECTION

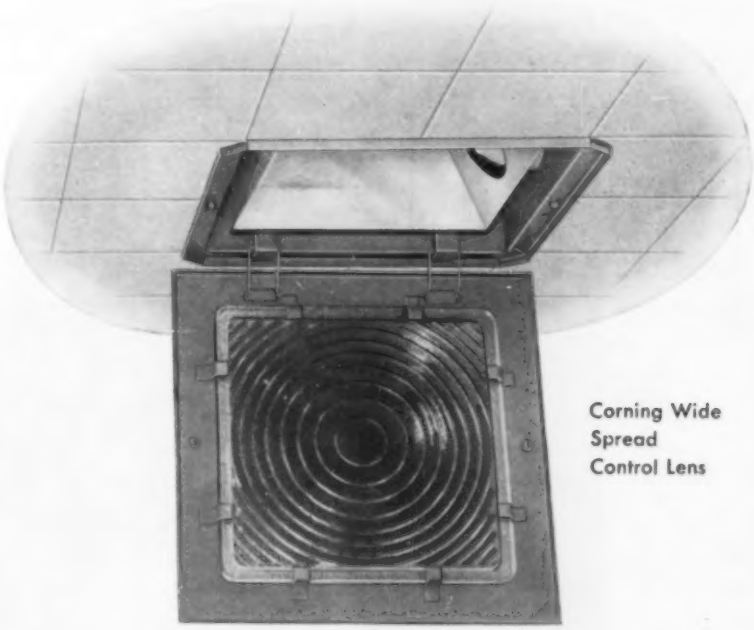
Associate Members:
Jensen, R. F., Boeing Airplane Co., Renton, Wash.
Peterson, C. C., Home Electric Co., Tacoma, Wash.

(Continued on page 58A)

INTRODUCING

NOVELTY'S NEW

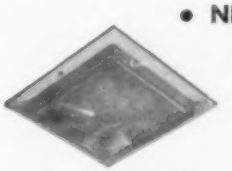
RECESSED **1100** LINE



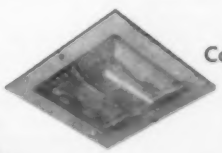
Corning Wide Spread Control Lens

- SPRING HINGE DROP FACE
- CONTROL LENSES
- CHOICE OF GLASS STYLES
- NEW LOW PRICE

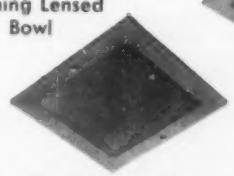
APPROVED BY UNDERWRITERS' LABORATORIES INC.



Corning Lensed Bowl



Corning Asymmetrical Lenslite



Flat Prisalite Glass

Architectural Cast Glass

WRITE TODAY FOR FOLDER NO. 215

Also available in round and rectangular models

Designers and Manufacturers . . . Since 1905

THE NOVELTY LIGHTING CORP.

2490 EAST 22nd STREET CLEVELAND 15, OHIO

(Continued from page 57A)

Shearer, J. E., Boeing Airplane Co., Seattle, Wash.
Wiggs, R. L., Jr., Superior Electric Co., Seattle, Wash.
Winikoff, Neil, Neil Winikoff Co., Seattle, Wash.

QUEBEC CHAPTER

Associate Members:
Paquet, Maurice, Paquet & Bedard, Quebec, Que.
Hindle, R. W., 20 Wks Coy RCE (DND Army), Camp Valcartier, Que.
Larouche, P. M., Saguenay Electric Co., Ltd., Chicoutimi, Que.
Stone, A. A., Franklin Electrical Supply Co., Quebec, Que.

ROCHESTER SECTION

Associate Members:
Berend, L. N., 79 Pinecrest Drive, Rochester, N. Y.
Smith, D. L., Westinghouse Electric Supply Co., Rochester, N. Y.

ROCKY MOUNTAIN SECTION

Associate Members:
Goldhammer, P. D., Swanson-Rink & Associates, Denver, Colo.

ST. LOUIS SECTION

Associate Members:
Hawes, R. S., III, K-S-H Plastics Inc., High Ridge, Mo.
Siegerist, W. L., Cupples Products Co., Maplewood, Mo.

SAN JACINTO SECTION

Member:
*Ober, Edward C., W. L. Clinton & Associates, Houston, Texas.

SOUTHERN CALIFORNIA SECTION

Members:
*Hochenauer, G. A., Benjamin Electric Mfg. Co., Los Angeles, Calif.
*McCandless, R. M., University of California, Los Angeles, Calif.

Associate Members:
Andresen, C. J., 2290 Brentford Road, San Marino, Calif.
Conover, D. H., Smith & Thorp Ltd., Long Beach, Calif.
Heer, W. G., Los Angeles County Road Dept., Los Angeles, Calif.
Wanek, B. F., Los Angeles County, Los Angeles, Calif.

SOUTHWESTERN SECTION

Associate Members:
Brown, Kenneth, Graybar Electric Co. Inc., Dallas, Texas.
Fricke, F. H., III, Progress Mfg. Co., Dallas, Texas.

SUWANNEE RIVER CHAPTER

Associate Member:
Conant, R. A., Rt. 1, Box 957, Orange Park, Fla.

TAR HEEL SECTION

Associate Members:
McDaid, P. R., Crescent Electric Supply Co., Greensboro, N. C.
Mullen, Hugh, Globe Lighting Products Inc., Brooklyn, N. Y.

Student Member:
Schandler, Joseph, 47 Merrimon Ave., Asheville, N. C.

TORONTO SECTION

Associate Members:
Armstrong, Albert, Etobicoke Hydro Electric Comm., Toronto, Ont.
Callard, J. E., Dept. of Highways, Toronto, Ont.
Francis, S. C., Canadian Westinghouse Supply Co., Toronto, Ont.
Loach, A. G., Jiffy Fluorescent Sales, Toronto, Ont.
Mullock, J. D., Canadian General Electric Co. Ltd., Toronto, Ont.

Student Member:
Trim, W. A., Ryerson Institute of Technology, Toronto, Ont.

TWIN CITY SECTION

Associate Member:
Holmgren, A. G., North Central Electric Distributing Co., Minneapolis, Minn.

TWIN PORTS CHAPTER

Associate Member:
Brechlin, E. L., Minnesota Power & Light Co., Duluth, Minn.

UTAH SECTION

Associate Member:
Helms, W. L., Lustra Corp. of America, 36 Washington St., Brooklyn, N. Y.

VIRGINIA CHAPTER

Associate Member:
Stribling, M. C., Virginia Electric & Power Co., Norfolk, Va.

WESTERN MICHIGAN SECTION

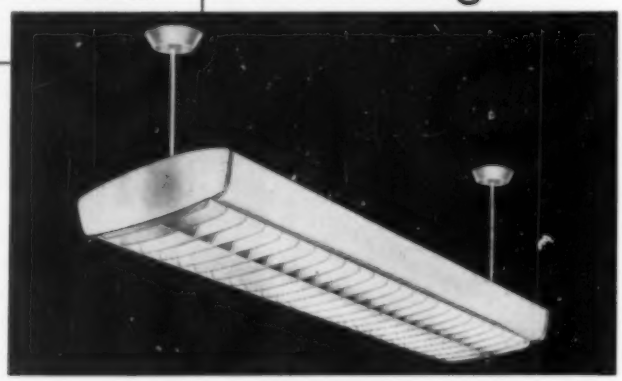
Member:
Ewing, W. B., Ewing Development Co., Grand Rapids, Mich.

Associate Members:
Brandt, H. J., Consumers Power Co., Kalamazoo, Mich.
Crittenden, D. K., Supply & Apparatus Sales, Kalamazoo, Mich.

YANKEE CHAPTER

Member:
*Barry, B. D., Jr., Northern Berkshire Electric Co., N. Adams, Mass.

SEEING is Believing



The Arthur

A & B 14000 SERIES

4 & 8 FOOT FLUORESCENT LUMINAIRES

Using standard or slimline lamps

A VERSATILE DIRECT-INDIRECT LUMINAIRE FOR INDIVIDUAL OR END-TO-END PENDANT MOUNTING

The 2-lamp Arthur, with its direct-indirect component is designed specifically for pendant mounting. Sloping ends, plus trim, shallow lines and all white finish give the unit a particularly light and graceful appearance.

Diffusing polystyrene side panels and 35° x 35° louver shielding result in an eye-comforting brightness pattern. When lighted, the Arthur blends harmoniously into the ceiling.

Open chassis construction makes the unit easy to install; all metal parts are die formed; 8-foot units require hangers only on the ends. Side panels slip into position; hinged louver opens or removes quickly. Unit is wired complete, ready to install, less lamps.

WRITE FOR BULLETIN NA *It details complete specifications and engineering data for the Arthur.*

PITTSBURGH REFLECTOR COMPANY

411 OLIVER BUILDING, PITTSBURGH 22, PA.

FLUORESCENT Pittsburgh REFLECTOR COMPANY INCANDESCENT

Lighting

IN CANADA
Pittsburgh Reflector of Canada, Ltd.
105 Tycos Drive, Toronto

REPRESENTATIVES IN PRINCIPAL CITIES • WHOLESALERS EVERYWHERE

In lighting
a religious
edifice, the
light meter
is almost
useless...
Because here
it is obvious
that emotional
effect—the
feeling you
create—is
more important
than footcandles.
(Century's lighting
instruments
are engineered
to meet the
necessities of
creative work.)

CENTURY
LIGHTING, INC.

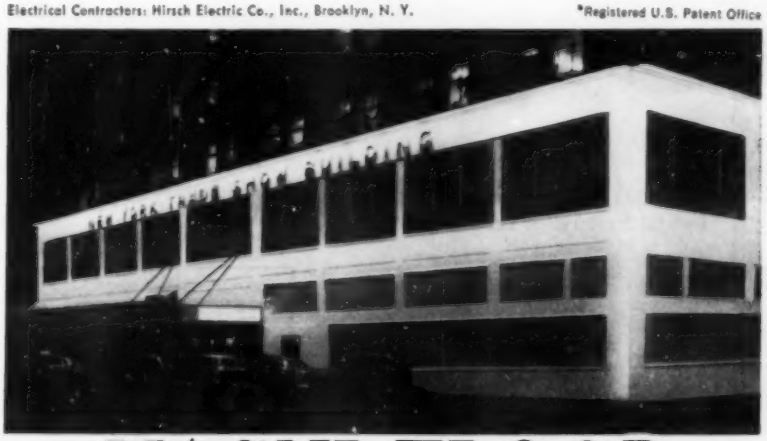
521 WEST 43rd ST.
NEW YORK 36, N. Y.
1820-40 BERKELEY ST.
SANTA MONICA, CALIF.
1477 N.E. 129th ST.
N. MIAMI, FLORIDA

ALL EXTRUDED ALUMINUM

Coping-Lite

OBJECTIVE: Well-distributed non-glare illumination for any building facade.
CONSTRUCTION: Exclusive one-piece construction in any length to 24'... in widths of 15" and 18". Interlocking sections and door frames of extruded aluminum . . . and end plates, mounting plates of cast aluminum. Clear-ribbed glass doors. Maximum weather-proofing throughout. In 3 finishes — natural aluminum, baked enamel, porcelain enamel.
INSTALLATION: Mounting plates (two to every 8 foot length) fasten to building. Fixture is easily locked into mounting plate and bolted.

Electrical Contractors: Hirsch Electric Co., Inc., Brooklyn, N. Y. *Registered U.S. Patent Office



MAGNI FLOOD

INCORPORATED

38 NORTH SECOND AVENUE • MOUNT VERNON, N.Y.

MOUNT VERNON 8-1385

Manufacturers of a complete line of outdoor floodlights and accessories.

In Canada, a Division of Wakefield Lighting Ltd., London, Ontario.

NEW LOW PRICES

FOR ATI GIMBAL RINGS!

New low prices for ATI GIMBAL RINGS mean bigger profits for you. And, the adaptability and versatility of these rings mean a more desirable line to sell your customers. ATI GIMBAL RINGS have many uses with PAR 38, 46, 56 and the NEW 64 sideprong lamps as well as the R30, R40 and PAR 38 screwbase lamps.

GIMBAL RING... for PAR 38, 46, 56 and the NEW 64 sideprong lamps.

GIMBAL RING... for R30 and R40 and PAR 38 screwbase lamps.

WRITE • WIRE • CALL FOR DETAILS

Alexander-Tagg Ind. INC. DEPT. IE
HATBORO, PA. OSBORNE 3-7200

THE ALL-NEW I.E.S.
Recommended Practice
for
OFFICE LIGHTING

Now ready in booklet form. Order copies now for your customers and contacts. Be the first with the facts on this vital subject. Single copies, 50¢.

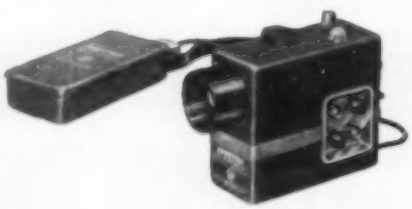
Publications Office
ILLUMINATING ENGINEERING SOCIETY
1860 Broadway, New York 23, N.Y.

LIGHTING ENGINEERS

Just in case
You are thinking of making a change
and are
A graduate Electrical Engineer or equivalent
who is
Interested in selling Street and
Airport lighting equipment
and would enjoy
Calling on Utilities and
Municipal electric departments
in a Better-Than-Average
Company supplied and maintained automobile
while earning an
Excellent Salary + Bonus + Profit Sharing +
Hospitalization Plan,
We Would Like To Talk With You
And will arrange an interview at your convenience.
Tell us about yourself
In a letter including your age, education, and
qualifications.

LINE MATERIAL COMPANY
Attention W. M. Dusenberry, Sales Manager
700 W. MICHIGAN STREET
MILWAUKEE 1, WISCONSIN

SPECTRA BRIGHTNESS SPOT METER



Spectra Meter Now Used by Lighting Engineers in . . .

Aircraft Industry
Electric Utilities
Architectural Firms
Motion Pictures & TV
Street & Highway Departments
Model Work
Human Engineering

Special Features of Standard Model:

Extreme Sensitivity Range
Direct Reading in ft-L
Locking Microammeter
Focusing 5′ to ∞
Small Angle

Other Models Available For Greater Sensitivity

DIRECT READING! All operators will obtain the same reading of the brightness of a given area.

Write for descriptive literature, complete specifications and information applying to your particular field to:

PHOTO RESEARCH CORP
837 N. CAHUENGA BLVD.
HOLLYWOOD 38, CALIF.

EMPLOYMENT OPPORTUNITIES

ELECTRICAL ENGINEER or ENGINEERING PHYSICIST

Recent graduate, major in illumination engineering and optics for training as assistant in photometric department of small but well established, employee-owned independent laboratory. Many employee benefits including non-contributory retirement and profit-sharing. Stock purchase opportunity. Work in fields of photometric, radiometric, colorimetric and spectrophotometric measurements, determinations and analyses on all types of illuminants, materials and equipment. Considerable work with industry and technical societies on standards, specifications, testing procedures and criteria. Interesting, important and wide ranging assignments. If qualified please send resume of education and experience, stating age and salary requirements, to E. H. Salter, Electrical Testing Laboratories, Inc., 2 East End Ave., New York 21, N. Y. Telephone BUtterfield 8-2600.

NEW YORK MANUFACTURERS' REPRESENTATIVE

with 9-year following of distributors, contractors, architects, and engineers requires incandescent fixture line. Three-man organization intends to supplement existing quality fluorescent line. Address Box 288, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

DESIGNER - ENGINEER

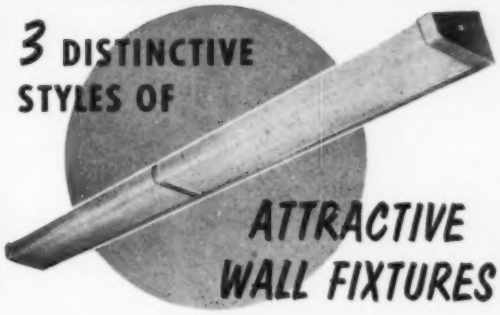
For incandescent and fluorescent lighting fixtures. Experience required in production and custom design, detailing and construction. Must be under 40, creative and artistic. Good future with recognized well-established San Francisco firm. Write in detail to Box 289, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

INDEX TO ADVERTISERS
November 1956

Abolite Lighting Division Jones Metal Products Co.	12A
Advance Transformer Co.	4A
Alexander-Tagg Ind. Inc.	60A
Benjamin Electric Mfg. Co.	Inside Front Cover
Century Lighting Inc.	59A
Certified Ballast Manufacturers	Inside Back Cover
Champion Lamp Works	56A
Corning Glass Works	41A, 54A
Curtis Lighting Inc.	5A
Day-Brite Lighting Inc.	1A
E. I. duPont de Nemours & Co., Inc.	44A
Fluorescent Fixtures of Calif.	29A
Garden City Plating & Mfg. Co.	20A
General Electric Co., Apparatus	34A
General Electric Co., Lamp	30A
Gibson Manufacturing Co.	48A
Edwin F. Guth Co.	Back Cover
Holophane Co. Inc.	25A
Jefferson Electric Co.	26A, 46A
Kopp Glass Inc.	11A
K S H Plastics Inc.	23A
Light & Power Utilities Corp.	55A
Litecontrol Corp.	6A
Magni Flood Inc.	59A
McPhilben Manufacturing Co.	50A
National Lighting Bureau	50A-51A
Northern Light Co.	61A
Novelty Lighting Corp.	57A
Perfeclite Company	37A
Pfaff & Kendall	49A
Photo Research Corp.	60A
Pittsburgh Reflector Co.	58A
Rambusch Decorating Co.	15A
Rohm & Haas Co.	33A
Rotuba Extruders Inc.	45A
Smithcraft Lighting Div.	47A
Sola Electric Co.	18A-19A
Starring & Company Inc.	2A
Sunbeam Lighting Co.	17A
Sylvania Electric Products Inc.	38A
Westinghouse Electric Corp., Lamps	42A, 52A-53A
Westinghouse Electric Corp., Lighting	62A
J. A. Wilson Lighting & Display Inc.	43A

MILWAUKEE ALBA MIRROR-LITE

3 DISTINCTIVE STYLES OF ATTRACTIVE WALL FIXTURES



Three distinctive styles to complement the finest interior design. Use Milwaukee ALBA MIRROR-LITE wherever wall-mounted light is needed—above doorways, lavatories, writing desks, along lobby walls, etc. Particularly effective above mirrors because opal Alba-Lite gives soft, flattering illumination . . . no harsh glare or shadows.

Beauty and simplicity of bent Alba-Lite is uncluttered by frameworks. 20-gauge one-piece steel channel and welded box stiffeners provide durability and strength without excess weight. Available in 2', 4', 6', 8' and longer lengths. Any type ballast and lamp can be used. Easy to lay out, easy to handle and easy to maintain.

Write for Bulletin 141-1 OR SEE YOUR ELECTRICAL SUPPLIER

NORTHERN LIGHT COMPANY MILWAUKEE 1661 N. WATER ST.

Is *YOURS* The Latest?...

You can't be sure you have *all the facts* about lighting unless you have a copy of the new . . .

Second Edition

I.E.S. LIGHTING HANDBOOK

Prepared by I.E.S. technical committees, this 987-page lighting compendium contains 18 sections of lighting practice, theory and calculations . . . Appendices . . . Manufacturers' Reference Data . . . 655 photos, drawings, lighting tables, charts, graphs, to help you solve tough lighting problems.

If your problems are lighting problems, don't be another day without the new I.E.S. LIGHTING HANDBOOK.

Price . . . $8.00

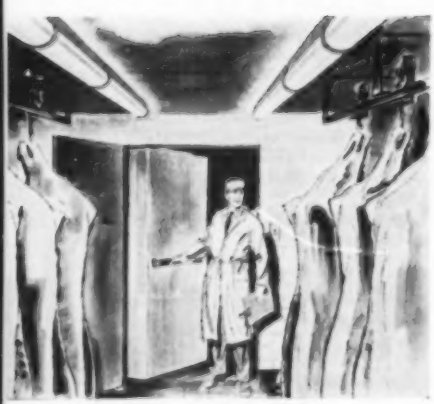
I.E.S. Members: If you have not ordered, your special member copy is only $5.50 now.

ORDER NOW!

Publications Office

ILLUMINATING ENGINEERING SOCIETY
1860 BROADWAY NEW YORK 23, N. Y.

Now... a luminaire that operates in freezing temperatures!



The new Westinghouse LT operates in low or variable temperatures — making it ideal for lighting cold storage warehouses, food lockers, shipping platforms and marquees.

Designed in cooperation with the Refrigeration Institute, the Westinghouse LT luminaire gives low heat output and high light output. A clear, ribbed plastic enclosure protects the lamp from air currents to insure maximum efficiency of the F72T-12, 100-watt, rapid-start lamps. In addition, the LT's porcelain finish resists corrosion in moist atmospheres and enhances its appearance. Why gamble with fixtures that were designed for other purposes.

Doesn't the LT suggest an application to you?

For real lighting quality, specify the Westinghouse LT luminaire.

See your Westinghouse distributor or write, Westinghouse Electric Corp., Lighting Division, Edgewater Park, Cleveland, Ohio.

Look for other new Westinghouse lighting products . . . soon to be announced!

J-04399-B X

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

HERE'S WHY

CERTIFIED CBM CERTIFIED by ETL BALLASTS

ENJOY A PREFERENCE OF NEARLY 2 TO 1

In 1955, nearly 2 out of 3 HPF ballasts were CERTIFIED CBM BALLASTS.

There is just one reason for this preference:

CERTIFIED CBM BALLASTS assure more satisfactory and economical fluorescent lighting.

Built to exacting specifications that provide the precise electrical needs of fluorescent lamps, and periodically checked by Electrical Testing Laboratories, Inc., CERTIFIED CBM BALLASTS are your assurance of:

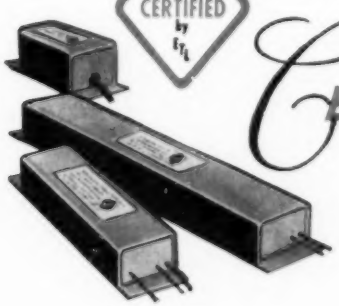
RATED LIGHT OUTPUT • RATED LAMP LIFE
LONG BALLAST LIFE • TROUBLE-FREE OPERATION
FREEDOM FROM NOISE

. . . all contributing to better lighting, lower maintenance cost and more economical fluorescent operation.

*Total ballast sales from U. S. Dept. of Commerce. CERTIFIED CBM BALLAST sales from ETL reports.

Send for free booklet, "Why It Pays to Use CERTIFIED CBM BALLASTS in Fluorescent Lighting Fixtures".

CBM CERTIFIED by ETL



CERTIFIED BALLAST MANUFACTURERS

2116 KEITH BUILDING • CLEVELAND 15, OHIO

Seven of the country's leading manufacturers of ballasts make CERTIFIED CBM BALLASTS. Participation in CBM is open to any manufacturer who wishes to qualify.

GUTH-LIGHT guards

THE EYES OF TEXAS!

4,200 GUTH TROFFERS.... ALZAK ALUMINUM LOWEST LOW-BRIGHTNESS TROFFERS IN NEW U.S.A.A. BUILDING, SAN ANTONIO

Texans think big and demand the best! That's why designers chose Guth Troffers for the magnificent new home office of United Services Automobile Association, San Antonio.

Their distinctive, custom-made look adds beauty to the contemporary decor... the shadowless, low-brightness lighting (with at least 65 ft. candles throughout) assures eye-ease and efficiency. What a combination!

And more: Guth's complete-unit design made the installation double-easy. No on-the-job assembly... they're ready to hang.

ARCHITECTS: Phelps & Dewees & Simmons-Atlee
B. & Robt. M. Ayres, San Antonio

ELECTRICAL DISTRIBUTOR: Southern Equipment Co., San Antonio

ELECTRICAL CONTRACTOR: Paul Wright Electrical Co., San Antonio

STRUCTURAL ENGINEERS: Matthews & Kenan, San Antonio and Beretta, Greenslade, Clark & Collins, Inc., San Antonio

MECHANICAL ELECTRICAL ENGINEERS: Gerard M. Baker, San Antonio, and Beretta, Greenslade, Clark & Collins, Inc., San Antonio

WRITE FOR GUTH TROFFER CATALOG NO. 50-I

THE EDWIN F. Guth COMPANY · ST. LOUIS 3, MO.

TRUSTED NAME IN LIGHTING SINCE 1902